Model 7300

Service Manual

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Part Number 9226-90-03

Respironics Novametrix, Inc.
5 Technology Drive
Wallingford, Connecticut, U.S.A. 06492.

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Service Department

For factory repair service:
Call toll free: 1-800-243-3444
To Call Direct: (203) 265-7701
Facsimile (203) 284-0753
http://www.novametrix.com
techline@novametrix.com

Caution: Federal (U.S.A.) law restricts this device to sale, distribution, or use by or on the order of a licensed medical practitioner.

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1 Safety

For maximum patient and operator safety, observe the following warnings, cautions and notes.

1.1 Warnings

WARNING:
Indicates a potentially harmful condition that can lead to personal injury.

- Explosion Hazard: Do not use the NICO® monitor in the presence of flammable anesthetics. Use of this instrument in such an environment may present an explosion hazard.
- Electrical Shock Hazard: Always turn the NICO monitor off before cleaning it. Do not use with a damaged external power source. Refer servicing to qualified service personnel.
- Connect the AC Mains power cord to a properly grounded hospital-grade outlet. The NICO monitor should be connected to the same electrical circuit as other equipment in use on the patient. Outlets of the same circuit can be identified by members of the hospital's engineering department.
- Failure of Operation: If the monitor fails to respond as described, do not use it until the situation has been corrected by qualified personnel.
- Reuse (disassembly, cleaning, disinfecting, resterilizing, etc.) of the CO_2, CO_2/Flow and NICO Sensors may compromise device functionality and system performance and cause a potential patient hazard. Performance is not guaranteed if a sensor is reused.
  - Inspect the CO_2, CO_2/Flow, SpO_2 and NICO Sensors prior to use.
  - Do not use if they appear to be damaged or broken.
  - Do not attempt to rotate the NICO Sensor in the breathing circuit by grasping the pneumatic tubes exiting the flow sensor.
  - Do not apply excessive tension to any cable or pneumatic tubing.
  - Periodically inspect sensor tubing lines for kinks.
  - Replace the CO_2/Flow or NICO Sensor if excessive moisture or secretions are observed in the tubing.
- The NICO monitor automatically identifies the type of sensor (small, standard or large NICO Sensor, or neonatal, pediatric or adult CO_2/Flow sensor) when it is connected. If a sensor identification message is not displayed when a sensor is first connected, DO NOT use the sensor. If the condition persists, refer the monitor to qualified service personnel.

- Do not use the NICO monitor if it is unable to properly identify a CO_2/Flow sensor or a NICO Sensor. If the condition persists, refer the monitor to qualified service personnel.
- In the event the message NICO SENSOR FAILURE is displayed, remove the NICO Sensor from the patient circuit.
- The CO_2/Flow or NICO Sensor connector should be properly inserted into the front panel receptacle prior to connecting a sensor to the breathing circuit, in order to avoid a circuit leak, or occlusion of sensor tubing.
- NICO Sensors increases airway deadspace by 35 cc (minimum). At low tidal volumes, compensatory changes to ventilation protocol should be considered.
- NICO Sensors are not for pediatric use.
- Patient Safety: Care should be exercised to assure continued peripheral perfusion distal to the SpO_2 sensor site after application.
- Inspect the SpO_2 sensor site for adequate circulation at least once every four hours.
- When applying sensors take note of patient's physiological condition. For example, burn patients may exhibit more sensitivity to heat and pressure and therefore additional consideration such as more frequent site checks may be appropriate.
- Periodically check sensors and tubing for excessive moisture or secretion build up. Although the NICO monitor automatically purges the lines, excessive moisture or secretions may still remain.
- While using the sensors, a system leak, such as that caused by uncuffed endotracheal tubes or a damaged sensor may significantly affect flow related readings. These include flow, volume, pressure, deadspace, CO_2 production and other respiratory mechanics parameters.
- Do not position sensor cables or tubing in any manner that may cause entanglement or strangulation.
- The NICO monitor is not intended to be used as an apnea monitor.
- The NICO monitor has no protection against the ingress of water.

1.2 Cautions

CAUTION:
Indicates a condition that may lead to equipment damage or malfunction.

- Use only Novametrix approved sensors and accessories with the NICO monitor.
- Do not operate the NICO monitor when it is wet due to spills or condensation.
- Do not operate the product if it appears to have been dropped or damaged.
- Never sterilize or immerse the monitor in liquids.
- Do not sterilize or immerse sensors except as directed in this manual.
- No tension should be applied to any sensor cable or tubing.
- To avoid the effects of excessive moisture in the NICO Sensor, insert it in the ventilator circuit with the pneumatic tubes upright. Excessive moisture in the NICO Sensor may affect the accuracy of the measurements.
- To avoid the effects of excessive moisture in the measurement circuit, insert the CO_2/Flow sensor in the ventilator circuit with the tubes upright. Improper placement may result in erroneous data.

- Excessive moisture in the CO_2/Flow sensor tubing may affect the accuracy of the measurements.
- It is recommended that CO_2/Flow or NICO Sensors be removed from the circuit whenever an aerosolized medication is delivered. These medications may contaminate the sensor windows, causing the sensor to fail prematurely.
- Operate the monitor at temperatures between 10 to +40° C (50 to 104° F), 10-95% R.H. non-condensing.
- Avoid storing the monitor at temperatures less than -10° C or greater than +55° C (<14° F or >131° F) 10-95% R.H. non-condensing
- Observe precautions for electrostatic discharge (ESD) and electromagnetic interference (EMI) to and from other equipment.
- Where electromagnetic devices (i.e., electrocautery) are used, patient monitoring may be interrupted due to electromagnetic interference. Electromagnetic fields up to 3 V/m will not adversely affect system performance.
- Caution: Federal (U.S.A.) law restricts this device to sale, distribution, or use by or on the order of a licensed medical practitioner.

1.3 Notes

NOTE:
A point of particular interest or emphasis intended to provide more efficient or convenient operation.

- In order to ensure proper monitoring of oxygenation and ventilation:
  - The use of pulse oximetry is recommended during monitoring with the NICO system.
  - Setting of $ETCO_2$ and SpO_2 alert limits is recommended.
- A “NO RESPIRATION” alert is not generated when both the CAPNOSTAT® CO_2 sensor and the NICO Sensor or CO_2/Flow sensor are disconnected from the NICO monitor.
- Be certain that the monitor is not in Demo mode while monitoring. Demo mode can be identified by the flashing DEMO MODE label in the General Message area of the display. To exit Demo mode and return to normal monitoring mode, turn the power off and back on.
- The NICO monitor contains no user serviceable parts. Refer servicing to qualified service personnel. A technical Service Manual is available for use by technical personnel.
- Do not attach an SpO_2 sensor distal to a blood pressure cuff. Valid data cannot be processed when the cuff is inflated. Attach the sensor to the limb opposite to the site used for the blood pressure cuff.
- This product and its accessories which have patient contact are free of latex.
- The NICO monitor is Year 2000 compliant.
- Data Validity: Inaccurate SpO_2 and Pulse Rate values may be caused by:
  - Incorrect application or use of a sensor
  - Significant levels of dysfunctional hemoglobin; carboxyhemoglobin or methemoglobin
  - Significant levels of indocyanine green, methylene blue, or other intravascular dyes
  - Exposure to excessive illumination such as surgical lamps—especially ones with a xenon light source, or direct sunlight

- Excessive patient movement
- Venous pulsations
- Electrosurgical interference
- Use of an IABP.

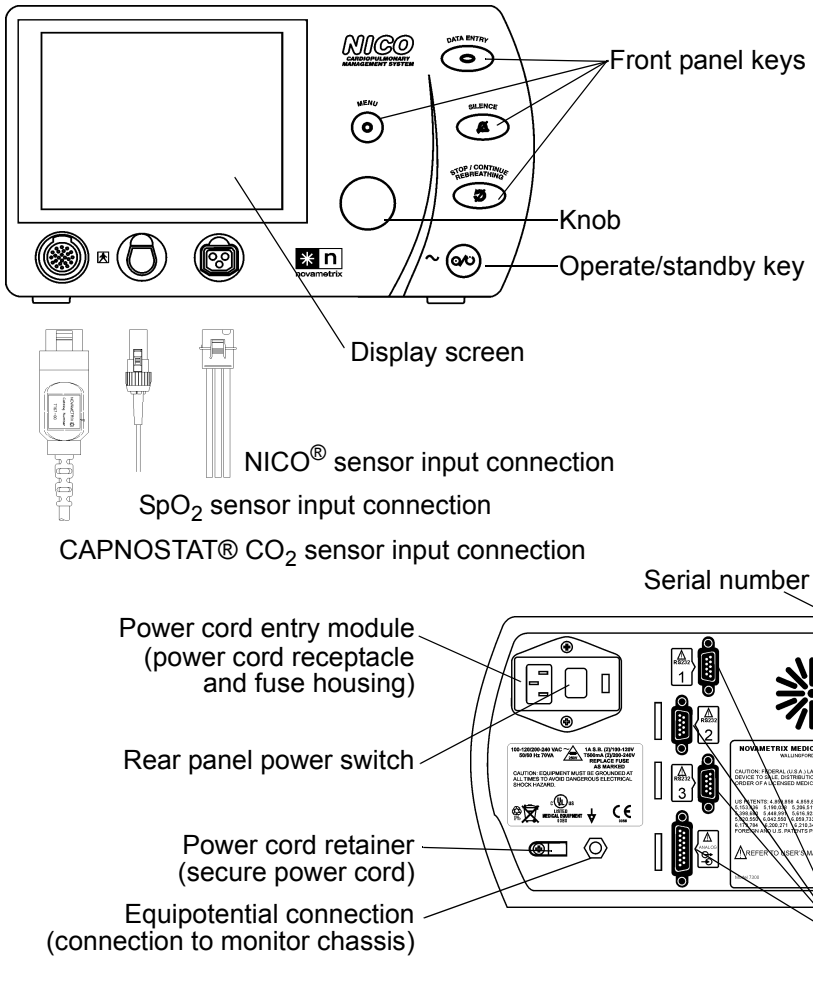
- The NICO monitor provides C.O. measurements when the following conditions are met:
  - The NICO Sensor assembly is properly installed in the patient's breathing circuit.
  - Valid flow and CO_2 signals are detected with no significant signal artifact.
  - VCO_2 is greater than 20 mL/min.
  - $ETCO_2$ is between 15 and 85 mmHg (2.0 - 11.5 kPa or %) during baseline
  - $ETCO_2$ is between 15 and 100 mmHg (2.0 - 13.5 kPa or %) during rebreathing
  - The tidal volume is greater than 200ml (small and standard sizes)
  - The tidal volume is greater than 400 ml (large size).
  - The respiratory rate is between 3 and 60 br/min.
  - The STOP/CONTINUE REBREATHING key is not illuminated.
  - The NICO cycle is not paused by the monitor for any other reason (displayed in the C.O. message area).
- When a new CAPNOSTAT® CO_2 sensor is attached to the monitor, or is moved from one monitor to another, it must be zeroed before use.
- After the life cycle of the equipment and accessories has been met, disposal should be accomplished following national and local requirements.

2 Introduction

2.1 About this manual

This document contains information which is proprietary and the property of Respironics Novametrix, Inc., and may not be reproduced, stored in a retrieval system, translated, transcribed, or transmitted, in any form, or by any means, without the prior explicit written permission of Respironics Novametrix, Inc. Novametrix reserves the right to change specifications without notice.

2.2 Front and Rear Illustrations



2.3 NICO® Monitor Technical Description

Per requirements of IEC 601-1, the NICO® monitor is classified as class II equipment, internally powered, with type BF applied part, and an enclosure protection rating of IPX0. The NICO® monitor is Year 2000 compliant.

Transport/Storage: -10 to +55° C (14-131° F), 10-95% R.H. non-condensing
Operating Conditions: 10 to +40° C (50 to 104° F), 10-90% R.H. non-condensing

2.4 Manufacturing Quality & Safety

The Respironics Novametrix, Inc. manufacturing facility is certified to both ISO 9001 and EN46001 (MDD93/42/EEC Annex II). Novametrix' products bear the "CE 0086" mark. The product is certified by Underwriter's Laboratories (UL) to bear the UL mark; and tested by TÜV Rheinland to IEC 601-1/EN60601-1.

Respironics Novametrix, Inc.

5 Technology Drive
Wallingford, CT 06489
U.S.A.

CE 0086

2.5 Declaration of Conformity with European Union Directive

The Authorized Representative for Novametrix equipment is:

D.R.M. Green
European Compliance Services Limited,
Oakdene House,
Oak Road,
Watchfield
Swindon, Wilts SN6 8TD
United Kingdom

2.6 Trademarks and Patents

CAPNOSTAT, NICO, $NICO_2$ are registered trademarks (®); CObar (cardiac output confidence bar), SuperBright and Y-Sensor are trademarks (™) of Respironics Novametrix, Inc. Other trademarks and registered trademarks are the property of their respective owners.

The NICO® monitor and its sensors and accessories are covered by the following USA patents: 4,859,858, 4,859,859, 4,914,720, 5,146,092, 5,153,436, 5,190,038, 5,206,511, 5,251,121, 5,347,843, 5,369,277, 5,379,650, 5,398,680, 5,448,991, 5,535,633, 5,616,923, 5,693,944, 5,789,660, 5,793,044, 5,820,550, 5,891,026, 5,999,834, 6,042,550, 6,059,732, 6,098,622, 6,099,481, 6,126,610, 6,179,784, 6,200,271, 6,210,342, 6,227,196, 6,238,351, 6,241,681, 6,258,038, 6,306,098, 6,312,389, D424,193. Other patents pending.

2.7 Manual Revision History

27-Aug-99	Release
2-Jul-02	Revision 01, R-N1013
19-Nov-02	Revision 02, CO-N0020
9-Jul-03	Revision 03, CO_N0390

3 Theory of Operation

3.1 NICO® Model 7300 Non-Invasive Cardiac Output Monitor

The NICO® model 7300 monitor measures cardiac output based on changes in respiratory CO_2 concentration caused by a brief period of rebreathing. The measurement of cardiac output is accomplished by interpreting data collected by proprietary sensors that measure flow, airway pressure, and CO_2 concentration, and then combining these signals to calculate CO_2 elimination. Using these variables, a technique known as Fick partial rebreathing is applied to calculate cardiac output. NICO® can be used with mechanically ventilated patients in the operating room, intensive care, or emergency departments.

3.2 Digital Board 2763

3.2.1 Microprocessor

Refer to sheet 1 of the 2763-03 schematic.

The generation of the logic and control signals for the purpose of acquiring the raw physiological parameters, and management of the data needed to produce an accurate Non-Invasive Cardiac Output, are the responsibilities of microprocessor **IC1**. This device, a Motorola MC68332, is a highly integrated 32-bit microcontroller that combines high-performance data manipulation capabilities with powerful peripheral subsystems. These subsystems include circuitry for timing generation, peripheral chip selection and data control, interrupt generation, as well as synchronous and asynchronous serial communication. Also included is a sophisticated timing co-processor, the TPU (Time Processor Unit), that can generate complex timing waveforms independent of the main processor. In general, the signals for subsystems are functionally grouped into ports which can be independently programmed by software to be a pre-defined port function or discrete I/O. Additionally, the functionality for several ports (Ports C, E and F) can be pre-defined by the state of specific data bus lines on system power-up. Included is a special “background mode” port that allows the device to be externally controlled, facilitating system debugging and testing. Also integrated on-chip are several activity monitors as well as a software watchdog to ensure proper device and system operation. Refer to table 1.

Port	Defined Function	Functionality & Power-up Control
TPU 16 Channels	Timing Signal Generation	Each channel independently user programmable as TPU function or as Discrete I/O

Table 1: CPU Port Functions

QSM 4 Synchronous Serial Chip Selects & one asynchronous serial channel	Serial Communications Port: QSPI: Queued Serial Peripheral Interface SCI: Serial Communications Interface	QSPI chip selects independently user programmable, can be used as Discrete I/O or decoded to create up to 16 chip selects. SCI transmit can be programmed as Discrete I/O
Background Mode	System debugging	Allows an appropriate external device to control the microprocessor and system
C	Chip Selects	D0: CSBOOT* Data Width, 8 or 16-bit D1: CS1*-CS3* or BR*,BG*,BGACK* D2: CS3*-CS5* or FC0-FC2 D3-D7: CS6*-CS10* or A19-A23
E	Bus Control	D8: Control Signals or Discrete I/O
F	MODCK and Interrupts	D9: MODCK & IRQ or Discrete I/O

Table 1: CPU Port Functions

The operating frequency of the system clock in the *NICO*® system is 24.117 MHz. It is generated by an internal VCO (Voltage Controlled Oscillator) derived from **Y1**, a 32.768KHz watch crystal, and is software programmable. The Timing Processor Unit (TPU) co-processor of the MC68332 provides complex timing functions generated from the system clock. This feature is utilized to control the precise timing required for the acquisition of the End Tidal Carbon Dioxide ($etCO_2$) and saturation (SpO_2) signals. The TPU is also used to generate the PWM (Pulse Width Modulation) control for the Capnostat Case and Detector heaters, and to provide the frequency generation for the audio tones. See Tables 2 and 3.

Signal	Name	Function / Timing
CO2AZ	Auto Zero	Clears the Sample/Hold circuitry prior to data acquisition. Active High, 90 us
CO2PWENB	Pulse Width Enable	Defines the active time for both phases of the bipolar source pulse, used for pulse width protection circuitry. Active High, 810 us
SRCDRV0	Source Drive 0	First source drive signal. Active High, 405 us
CO2CSHL	Current Sample/Hold	Enables circuitry for source current measurement. Sample is taken when SRCDRV0 is active. Low = Sample, 90 us, High = Hold
SRCDRV1	Source Drive 1	Second source drive signal delayed for 10 microseconds after SRCDRV0 ends. Active High, 395 us
CO2SSH	Signal Sample/Hold	Enables circuitry for CO_2 and Reference channel data acquisition. Low = Sample, 90 us, High = Hold
CASEPWM	Case Heater PWM	PWM control for the case heater servo
DETPWM	Detector Heater PWM	PWM control for the detector heater servo

Table 2: TPU Timing Generation for the $etCO_2$ subsystem

TOUT1, TOUT2	Tone Generation	Variable frequency outputs to generate system audio

Table 2: TPU Timing Generation for the $etCO_2$ subsystem

Signal	Name	Function / Timing
ASAMPL	Auto Zero	Clears the Sample/Hold circuitry prior to data acquisition. Active Low
RDLEDL	Red Channel LED control pulse	Defines the active time for the Red LED. Active Low
IRLEDL	Infra-Red Channel LED control pulse	Defines the active time for the Infra-Red LED. Active Low
RSAMPL	Red Channel Sample/Hold	Enables circuitry for the Red Channel signal measurement. Sample is taken when SRCDRV0 is active. Low = Sample, 90 us, High = Hold
ISAMPL	Infra-Red Channel Sample/Hold	Enables circuitry for the InfraRed Channel signal measurement. Sample is taken when SRCDRV0 is active. Low = Sample, 90 us, High = Hold

Table 3: TPU Timing Generation for the SpO_2 subsystem

To help reduce and suppress the radiation of electromagnetic interference, ferrite filters (**L1-L11)** have been placed on clock signals with fast rise and fall times. Other digital signals, including address and data lines, are rise-time limited by the addition of small valued resistors and / or capacitors. In addition, good EMI/EMC design techniques have been incorporated in the component layout and printed circuit board manufacture.

Table 4 lists the chip select, control and discrete I/O functions for the *NICO*® system module. On power-up, Ports E and F are programmed as discrete inputs by pulling down their controlling data lines, DB8 and DB9. After power-up, the software sets up each pin function individually and performs a series of self-tests to check the integrity of the system. During this period, the MPU holds the SYSUP line low which keeps the system in the initialization state. The state of configuration inputs on Port E (CNFG0, CNFG1 and CNFG2) and on data input buffer **IC10** (see sheet 2 on 2763-03 schematic) (JP1, JP2, JP2, JP4, TP4, TP5 and TP6) are read. These inputs allow the software to identify different operating conditions, such as Manufacturing Diagnostic Mode, or to recognize different hardware configurations. After the initialization period is complete and all system functions have been set, the MPU brings the status signal SYSUP high, indicating that the system is ready for patient monitoring operation.

Port	Pin Functions	System Signal Name[1]	I/O	Comments
C	DATA0 thru DATA7		O	D0-D7 pulled high, Pins are Chip Select on power-up
	CSBOOT*	ROMOEL	O	Program PROM Chip Select Word (16-bits) wide mode, D0 = HIGH
	CS0* / BR*	UBRAMWRL	O	Upper Byte SRAM Write Enable Allows for byte (8-bit) or word writes
	CS1*/ BG*	LBRAMWRL	O	Lower Byte SRAM Write Enable Allows for byte (8-bit) or word writes
	CS2* / BGACK*	SRAMOEL	O	SRAM Read Enable, Word
	CS3* / PC0 / FC0	ROMWRL	O	FLASH PROM Write Enable, Word
	CS4* / PC1 / FC1	UARTCSL	O	High Speed quad UART Chip Select
	CS5* / PC2 / FC2	BOOTWE	O	Port C Discrete Output, prevents unintentional writes to FLASH EPROM. This signal must be asserted before ROMWR* in order to overwrite the FLASH
	CS6* / PC3 / A19	A19	O	High Address line A19
	CS7* / PC4 / A20	RTCCSL	O	Real Time Clock Chip Select
	CS8* / PC5 / A21	DISPCSL	O	EL Display Chip Select
	CS9* / PC6 / A22	VRAMCSL	O	Video Memory Chip Select
	CS10* / ECLK / A23	CASCADEL	O	Cascaded Chip Select for Additional Parallel Peripherals
E	DATA8		O	D8 pulled low, Discrete I/O on power-up
	DSACK0* / PE0	CNFG2	I	Configuration Switch 2
	DSACK1* / PE1	DS1L	I	Data and Size Acknowledge 1*
	AVC* / PE2	CNFG0	I	Configuration Switch 0
	RMC* / PE3	CNFG1	I	Configuration Switch 1
	DS* / PE4	DSL	O	Data Strobe
	AS* / PE5	ASL	O	Address Strobe
	SIZ0* / PE6	SIZ0	O	Signifies current operation is 8-bit data
	SIZ1* / PE7	CNFG2	I	Configuration Switch 2
	R/W*	RDL	O	Data Read Strode
		WRL	O	Data Write Strobe

Table 4: Chip Select, Control and Discrete I/O

F	DATA9		O	D9 pulled low, Discrete I/O on power-up
	MODCLK / PF0	LED	O	LED CPU Activity Indicator
	IRQ1* / PF1	SYSUP	O	System Initialization Complete
	IRQ2* / PF2	CSOFTOT	O	Case Heater Over Temperature Shut Down
	IRQ3* / PF3	DSOFTOT	O	Detector Heater Over Temperature Shut Down
	IRQ4* / PF4	UARTIRQL	I	External UART Interrupt
	IRQ5* / PF5	EXTDCIN	I	Indicates external AC MAINS power operation
	IRQ6* / PF6	PWRDWN	O	System power down enable
	IRQ7* / PF7	NMIL	I	Non-Maskable Interrupt

Table 4: Chip Select, Control and Discrete I/O

1.Signal names with an “L” suffix are active low signals.

3.2.2 Background Mode Debugging and Application Development

Refer to sheet 1 on 2763-03 schematic.

Background debugging of the system during applications development or during system testing is possible by connecting an appropriate external device (emulator or debugger) to header **J1**. The signals present on this header enable an external device to halt the current microprocessor bus activity. This turns control of the microprocessor system over to the external device, placing the microcontroller into Background Debugging Mode. In this mode, the internal MPU registers can be viewed and altered, special test features can be invoked and the system’s memory, and peripherals can be read and written to. To enable this, header J1 and 0 ohm resistors R106 and R107 need to be populated.

Refer to sheet 2 on 2763-03 schematic.

In addition to the inherent debugging capabilities of the microprocessor, the digital board also contains circuitry to monitor events during application development. Output latches **IC15** and **IC17** along with Profiling header **J4** are used to determine CPU utilization during system development, latching various status bits out on the header.

3.2.3 System Memory

Refer to sheet 1 on 2763-03 schematic.

A 16-bit wide data path is used for FLASH PROM and SRAM transfers to maximize system throughput. Non-volatile memory, used for the storage of the boot-up and main program code, is contained in **IC4**, a 1024K x 8-bit, 5V FLASH ROM. To initiate the data transfer process, the MPU brings the ROMOEL output signal LOW, causing a word of program data stored in the FLASH ROM to be sent out on the data bus from the appropriate memory address. Program data may be updated by commanding the device to erase a block of its present programmed data then using the ROMWRL signal to place new program data into the address specified by the MPU. The FLASH ROM is internally protected from unintentional overwrites of the boot code by requiring an independent signal, BOOTWE, going active in addition to ROMWRL. The BOOTWE line must be high prior to writing new boot code into the FLASH device. Two Static RAMs (**IC3 and IC6**) contain volatile data storage for use as a temporary data scratch pad during system operation and for recording patient trend information. To retain

patient trending data during periods of power down, the SRAMs are battery backed to retain their contents. A 2.5 Volt level VBACK generated from the main battery via IC30 on the 2764 Power Board, is supplied when the system is turned off and removed from the AC MAINS. During this battery backed-up state, transistor **Q1** keeps the chip enable control line of the SRAMs high and in a low power, inactive state. This forces the SRAMs data bus to a high impedance state, isolating the parts from the rest of the system. True non-volatile storage for system parameters is provided by a serial EEPROM (**IC8**), which has the ability to retain programmed information in the absence of power.

3.2.4 User Interface Control Circuitry

Refer to sheet 3 on 2763-03 schematic.

The user interface features a high contrast, 320 row by 240 column Electroluminescent Display module. Patient and system information is presented in both graphical and textual formats organized into several screen configurations. An integrated display controller, **IC19**, works in conjunction with the MC68332 MPU, and provides the necessary timing signal generation and housekeeping functions to display the visual information generated by the system. Programmable logic device **IC2** is designed to condition the logic signals between the MPU and display controller, making sure that the critical timing specifications of the two devices are met. SRAMS **IC18** and **IC22** provide video RAM storage for the display system. In addition to buffering the signals for the display interface, CPLD **IC2** also decodes chip selects for the system input buffers and output latches off of CASCADEL. If required, **IC2** can be reprogrammed in-circuit using header **J9**.

A 5-switch silicon keypanel and multifunctional rotary encoder provide operator control of screen selection, patient data entry, and user selectable input. The keypanel also contains several LEDs which represent various system conditions such as input power status (AC or Battery) and alarm state. Control of the user interface is generated from the CASCADEL chip select signal along with the appropriate address line state and WRL signals from the microprocessor. **IC10** and **IC13** (sheet 2 on schematic) are input buffers, which read in the present state of the keypanel and rotary encoder. Depressing a key or activation of the encoder causes the signal line associated to be pulled low, in contrast to its normally high state. Input buffer **IC14** provides a latched output for controlling the front panel LEDs as well as several other latched control outputs.

To supplement the visual indicators associated with the membrane keypanel and display, an audio output signal is generated to provide an additional mode to convey information to the user. The TPU processor of the MC68332 (TOUT1 and TOUT2) can generate two-tone frequencies. These signals are fed into separate reference inputs of the Quad 8-bit DAC, **IC20**, providing a means for independently attenuating each signal under CPU control. From the DAC, the individual signals are summed together by **IC21B** and filtered by **L11** and **C50**. Audio amplifier **IC23** drives the system speaker to produce system audio. Inverter **IC7F**, controlled by the SYSUP signal from the MPU, disables the audio amplifier until system initialization has been completed. DAC **IC23** also supplies an output voltage level SPO2VLED to set the current gain of the saturation drive circuit which is found on the *NICO*® Power PCB, 2764-01. The circuitry associated with the DACB output (including **IC21A**, **Q3** and **J6**) is presently not used.

3.2.5 Real Time Clock, Power on RESET Generation and Glue Logic

Refer to sheet 2 on 2763-03 schematic.

Time keeping for date and time stamping of patient trend information is provided by Real Time Clock **IC16**. This device contains a built in crystal for precise time and date

measurement. The *NICO*® system has been designed and tested for Y2K compliance. In the absence of AC power, the time keeping function is maintained by the battery backed-up supply, VBACK.

On power-up, the system is forced into a RESET state by **IC9** (sheet 1 on schematic). This chip creates the master active low system reset signal SRST*, holding up system initialization until a stable 5 VDC logic level is maintained. An inverter is used to generate RESET for devices that require an active high reset signal.

3.3 Power Supply 2764 (Power Supply and Communications)

3.3.1 Serial Communications UART

Refer to sheet 3 on 2764-03 schematic.

To enable serial communication with up to three external devices simultaneously, a Quad UART (Universal Asynchronous Receiver/Transmitter), **IC14**, is provided for buffered high-speed data communication. The connection to external, non-patient contact-type devices is electrically isolated from the patient applied sections by optical data couplers (**IC16, IC17, IC21, IC23, IC26**) and isolated winding off of the power supply flyback transformer, **T1**. Transceiver **IC13**, located on the patient-isolated circuit, provides signal translation between the system's TTL logic level and the RS-232 level requirements. Serial Ports A and C (**J1** and **J3**) are configured for a simple 3-wire (Transmit, Receive and Ground) connection, while Serial Port B (**J2**) has additional hardware handshaking capabilities. Connection to an external device is through a null-modem type of interface cable. The fourth UART channel is available on internal connector J5 for future product expansion. In addition, the system is capable of outputting four channels of analog output data through **IC22** and receiving four channels of analog input through buffer amplifiers **IC18** and A/D Converter **IC20** on connector **J4**. Voltage reference **IC19** supplies the analog I/O circuitry with a stable voltage level. Connector **J4** allows sensing of external cable connection by shorting pin 15 (IOSNSE) of the external cable to ground. Refer to Tables 5 to 8 for the pinout and signals of interface connectors.

J1		
Pin Number	**Signal**	**Function**
1	NC	No Connection
2	RxC	Serial Channel A Receive
3	TxC	Serial Channel A Transmit
4	NC	No Connection
5	Isolated Ground	Non-Patient Signal Ground
6	NC	No Connection
7	NC	No Connection
8	NC	No Connection
9	NC	No Connection

Table 5: Serial Channel A, 9-pin D-subminiature connector located on the rear panel

J2		
Pin Number	**Signal**	**Function**
1	NC	No Connection
2	RxB	Serial Channel B Receive
3	TxB	Serial Channel B Transmit
4	NC	No Connection
5	Isolated Ground	Non-Patient Signal Ground
6	NC	No Connection
7	RTSB	Request to Send Channel B, Hardware Handshake Output
8	CTSB	Clear to Send Channel C, Hardware Handshake Input
9	Isolated Power	Power

Table 6: Serial Channel B, 9-pin D-subminiature connector located on the rear panel

J3		
Pin Number	**Signal**	**Function**
1	NC	No Connection
2	RxA	Serial Channel C Receive
3	TxA	Serial Channel C Transmit
4	NC	No Connection
5	Isolated Ground	Non-Patient Signal Ground
6	NC	No Connection
7	NC	No Connection
8	NC	No Connection
9	NC	No Connection

Table 7: Serial Channel C, 9-pin D-subminiature connector located on the rear panel

J4		
Pin Number	**Signal**	**Function**
1	Isolated Ground	Non-Patient Signal Ground
2	ADCIN0	ADC Input Channel 0
3	ADCIN1	ADC Input Channel 1

Table 8: Analog Connector, 15-pin D-subminiature connector located on the rear panel

4	ADCIN2	ADC Input Channel 2
5	ADCIN3	ADC Input Channel 3
6	Isolated Ground	Non-Patient Signal Ground
7	Isolated Ground	Non-Patient Signal Ground
8	Isolated Ground	Non-Patient Signal Ground
9	Isolated Ground	Non-Patient Signal Ground
10	Isolated Ground	Non-Patient Signal Ground
11	DACOUT0	DAC Output Channel 0
12	DACOUT1	DAC Output Channel 1
13	DACOUT2	DAC Output Channel 2
14	DACOUT3	DAC Output Channel 3
15	IOSNSE	Cable connect sense input

Table 8: Analog Connector, 15-pin D-subminiature connector located on the rear panel

3.3.2 CO_2 Pulser Source Drive

The source drive circuitry is designed to drive the source with a bipolar signal to prevent the migration of charges within the source that may result from unidirectional electrical fields. The resistance of the source is monitored constantly to ensure the integrity of the system by sampling the current through the source while it is active.

Refer to sheet 1 on 2764-03 schematic.

The TPU co-processor in the MC68332 generates the timing signals that drive the power to the broadband infrared source located in the CAPNOSTAT CO_2 sensor. The SRCDRV0 and SRCDRV1 lines are used to control the direction of the current flow through the source. On the falling edge of CO2AZ (Auto Zero) and the rising edge of CO2PWENB (Pulse Width Enable), the SRCDRV0 signal goes High, enabling drivers **IC1A** and **IC2B** to turn on one half of the MOSFET H-Bridge formed by **Q1** and **Q2**. This causes current to flow through the P-Channel half of MOSFET **Q1**, through the CAPNOSTAT source, through the N-Channel half of MOSFET **Q2** and finally through **R23** to the negative supply rail, completing the first part of the Source Pulse cycle. The duration of SRCDRV0 is 405 us (microseconds). After the SRCDRV0 line goes Low, there is a 20 us software delay until the SCRDRV1 line goes High, enabling drivers **IC1B** and **IC2A** to turn on the other half of the MOSFET Bridge formed by the P-Channel half of **Q2** and the N-Channel half of **Q1**. This drives the current through the source in the opposite direction. The 20us software delay between the SRCDRV0 and SRCDRV1 signals is to prevent the possibility of both halves of the MOSFET bridge being active at the same time, thus creating a low impedance path between the two power supply rails.

When current flows through the source, it will also flow through current sensing resistor **R23**, creating a differential voltage proportional to the source current. This voltage is measured during the last part of the SCRDRV0 period by differential amplifier **IC3A**, and is inputted to **IC9** (see sheet 2 on schematic), a 12-bit, 11-channel A/D Converter

after being conditioned by the sample / hold circuit consisting of **IC4**, **IC5** and **C11**. The converter output of the sample / hold is processed in software to represent the current flowing through the CAPNOSTAT source:

$V_{SRC} = (V_{SR} / R_{SR}) * R_S * A_{V(DA)}$ where V_{SRC} = voltage out of difference amplifier proportional to current through the source element

= 24V +/- 0.625V

V_{SR} = differential voltage across the source element

R_{SR} = resistance of the source element

R_S = resistance of the current sensing resistor

= 1 ohm

$A_{V(DA)}$ = difference amplifier gain

= 5

V_{SRC} = [120 (Volts*Ohms) / R_{SR} (Ohms)]

For compatibility with present Novametrix monitors, the software displays the source current scaled by (1.1Vsrc) +17mV. In addition to monitoring the source current, the A/D Converter **IC9** also digitizes the feedback signals from the Saturation sensor and Power Supply.

In order to prevent the source from being driven until the system is up and ready, there is protection circuitry that inhibits the source drive until enabled. During system power-up, the RESET line keeps **Q3** on, preventing source pulses by pulling down SRCDRV0 and SCRDRV1 through **D3**. Protection circuitry also guards against extended pulse width as well as shortened duty cycle. On the rising edge of CO2PWENB, the trip point of **IC6B** is exceeded, bringing the output of **IC6B** high as **C12** charges through diode **D4**. This allows capacitor **C8** to charge up through **R22**. If the CO2PWENB signal does not turn the Source Pulser off within 200 us after the 810 us pulse period, the voltage across **C8** will exceed the trip point for **IC6A**, pulling the CO2INH line low and turning the Pulser off. After the CO2PWENB signal returns Low, capacitor **C12** is allowed to discharge through **R26**, keeping the output of comparator **IC6B** at the voltage acquired during the period when CO2PWENB was High. After approximately 7.2ms, **C12** will have discharged below comparator **IC6B**'s trip point. The comparator output goes low, discharging **C8** and the circuit is ready for the next source pulse cycle.

3.3.3 CAPNOSTAT Case and Detector Heater Control

Refer to sheet 2 on 2764-03 schematic.

The temperature of the CAPNOSTAT sensor system directly affects its ability to accurately measure CO_2. Two separate heaters and control circuits are used to maintain the sensor temperature at a precise value. One heater regulates the temperature of the detectors that detect the amount of infrared energy passing through the sample chamber; the other regulates the temperature of the transducer case (and loosely maintains the temperature of the airway adapter). While the purpose of the detector heater is to keep the detectors' sensitivity to infrared radiation constant, the function of the case heater is to keep condensation from forming on the airway windows by elevating the window temperature above the ambient airway temperature. Both heaters use an efficient Pulse-Width Modulation scheme designed to decrease power consumption, with the PWM timing generated by the TPU under microprocessor control. The MPU senses the voltage output from the CAPNOSTAT case and detector thermistors (circuit described in the Analog 2754-01 PCB discussion) and regulates the

output pulses from the TPU, creating a pulse duty cycle that is proportional to the amount of energy required to maintain the heater temperature. Dual MOSFET Driver **IC10** buffers the TPU signals to drive the gates of Dual P-Channel MOSFET **Q7**. These drive signals are AC coupled by capacitors **C24** & **C31** to ensure that if PWM pulses are lost for any reason, the MOSFET gates will be pulled up by resistors **R40** and **R47** which will turn the MOSFETs Off, removing power to the Capnostat heaters. Dual MOSFET **Q4** also controls power to the heaters, allowing independent over-temperature cut-off of each heater by both software and hardware watchdogs. **D6**, **L1** and **C25** help turn the pulses for the Case Heater from **Q7A** into a steady DC output, while **D8**, **L2** and **C32** smooth out the Detector Heater output from **Q7B**. Since the TPU-generated PWM signal is based on the system clock, it is synchronized with the generation of the source pulse timing. This minimizes the effect of any random disturbance caused by the heater circuit on the detection of the CO_2 Data and Reference signals.

3.3.4 Saturation LED Power Generation and LED Drive

Refer to sheet 2 on 2764-03 schematic.

Adjustable voltage regulator **IC11** is configured as a constant current supply for the Red and InfraRed (IR) saturation sensor LEDs. **R50** limits the current to Vref/R {1.25V/26.7 ohms} or 50mA, while Zener diode **D9** sets the maximum output voltage at 7.5 Volts. Capacitors **C36** and **C37** provide a reservoir for providing the instantaneous current demanded when the LEDs are turned on. Transistor **Q11** allows shutting down the power to the sensor LEDs by the microprocessor.

Connector **J4** on the *NICO*® 2765-01 Analog Board connects the saturation sensor to the monitor. Both of the saturation sensor LEDs are controlled by an amplifier configured as a constant current driver. The voltage control for the constant current drive, SPO2VLED, comes from DAC **IC20** on the *NICO*® Digital Board, 2763-01. The cathode of the Red LED channel is tied to the driver consisting of amplifier **IC12A**, MOSFET **Q10** and resistor **R57**. Since the amplifier is connected as a non-inverting amplifier, the voltage appearing at the positive terminal will also appear at the negative terminal and across **R57**. This voltage, nominally 0.74V, creates a current through **R50** of 225mA {0.74V/3.3 ohms} when the RDLED* signal is asserted which also flows through the Red LED of the Saturation sensor via **Q10**. The driver for the IR LED (**IC12B**, **Q13** and **R64**) creates a constant current source of 111mA across **R64** and is controlled by asserting the IRLED* signal. The two control signals operate at 3.3 kHz with a 10% duty cycle and are staggered so that one LED is on during the middle of the other LED's off time.

3.3.5 Power Supply and Voltage Reference Generation

The monitor operates either on isolated AC Mains power or on the internal 12-Volt Lead-Acid Battery. To provide isolation from the MAINS lines as well as AC/DC voltage conversion, the *NICO*® monitor utilizes a Medical Grade, universal input off-line switching power supply. The DC output of this supply is 15 VDC at 40 Watts, and is brought to the Power board on connector **J6** (sheet 5 on schematic). The heart of the power supply design for the system is a 100 kHz switching regulator, **IC34** (sheet 4 on schematic), which utilizes a flyback transformer configuration to generate the DC supply voltages and provide the required isolation between the primary, secondary and isolated power planes. Power On / Off control is achieved by sensing the state of the power switch located on the front panel. A high to low transition on the PWRSW line is debounced by **C85** and **IC31A**, and clocked into Flip-flop **IC32A**, which causes the Flip-flop output to toggle its present state. A high output causes switching regulator **IC34** to be turned on, supplying power to the system. Flip-flop **IC32B** provides control over the

state of the system when the user turns the system “Off”. When the monitor is operated from an AC MAINS power source the green AC ON indicator on the front panel is lit. If the monitor is on, pressing the power key on the front membrane keypanel will not power the monitor down. Instead, the monitor is placed in a standby operating mode. The display and other non-essential control functions are inactivated by the software, giving the monitor the appearance of power down. While in standby, however, the core system continues to operate, keeping the Capnostat heaters within temperature regulation. This reduces the time required to bring the system up to full operating specifications during the following power-up cycle. While on battery operation, depressing the Power Key on the front keypanel will turn off the switching regulator, thus powering down the system. Stand by mode is disabled and power to the system is turned off. The monitor enters a low power mode where only circuitry required for SRAM and real-time clock battery back-up and Power Key sensing is kept supplied. Power for the SRAM and Real-time clock, VBACK, is determined by the state of VDD. When VDD is available and transistor **Q23** is turned on, VDD is supplied through transistor **Q21**. In the absence of VDD, VBACK drops down to a low power level supplied through diode **D36**.

During system initialization, the switching frequency is synchronized to the main system clock by the components associated with **Q17** to reduce system data acquisition errors due to power supply interference. The nominal synchronized frequency is 156 kHz. The primary of transformer **T1** is designed to accept 10 to 24 V DC input and provides secondary outputs of nominally 5 VDC, +14 VDC, and -14 VDC. An additional winding pair is isolated by 2KV from the other transformer windings to provides 9VDC output for the earth connected and patient isolated serial and analog input and output circuitry. The 5VDC supply (VDD) provides feedback to the switching regulator by resistor divider **R108** and **R112**. The other windings are loosely regulated by the requirements of the 5 VDC supply by the ratio of the transformer windings, creating semi-regulated secondary voltages for the analog supplies of approximately +\-14VDC. The 5V supply is L-C filtered to provide clean logic supplies for both the digital logic (VDD) and the analog sections of the Digital and Power Boards (DVDD). Another filter isolates the 5-Volt supply for the Flow Pneumatics (VVDD) from the rest of the system. Regulators **IC33** and **IC36** are designed as a tracking regulator pair to provide a 24VDC differential voltage for powering the Capnostat source (+VSRC, -VSRC). The voltage level of the +VA supply is monitored by **IC35B** to ensure that a tight voltage range is maintained and not exceeded in the event that the +5 VDC feedback to the switching regulator, **IC34**, is lost. Linear regulator **IC27** provides the logic and analog supply for the patient-isolated circuits.

Power for the CAPNOSTAT heaters and the display are derived off of the main 15 Volt input from the offline switching regulator during connection to an AC MAINS power source. During AC operation, the signal LINEST is High, indicating the presence of AC MAINS. **IC37**, also a switching voltage regulator, and its associated circuitry provide these functions with a well-regulated 12 VDC supply. When the monitor is operating off of the internal battery, LINEST is Low, disabling the switching regulator and turning on MOSFET **Q19A** which is controlled by voltage comparator **IC35C**. In this mode, the heaters and display are supplied directly with battery power, minimizing power losses that occur during the conversion of one voltage level to another. The output from comparator **IC35C** also controls the Reset input to Flip-flop **IC32B**, determining whether the monitor is in AC stand-by or DC Power Down operating mode.

Charging the battery takes place as long as the unit is connected into a viable source of AC MAINS power and the power entry module switch is in the “On” position. In order to charge the battery as quickly and efficiently as possible, a two-step charging process is employed. Assuming the battery is in a depleted charge state, feedback to the low

drop-out linear regulator, **IC39**, sets the voltage output at a fast-charge level of approximately 14 VDC. Sensing the voltage drop across **R144**, comparator **IC40A** monitors the current draw of the battery, limiting it to approximately 250mA for a maximum charge rate of C/10. If the battery tries to draw current in excess of the amount allowed, **IC40A** turns off the regulator, thus limiting the charging current. As the battery reaches a fully charged state and the current draw decreases to approximately 50mA, **IC40B** turns transistor **Q27** off which causes the regulator to change its output to a float charge voltage of approximately 13.2 VDC, which maintains the battery in a constant state of readiness.

If AC power is lost or is not available, the monitor automatically operates from its internal battery without interruption. The AC ON indicator is extinguished and a BATTERY ICON appears on the display, indicating the current power level of the battery. While on internal DC power, the current state of the battery is monitored by both software and hardware (**IC29**, **IC28A** and **IC35A**). Should the battery power level get critically low, the monitor software, which monitors the VBATTADC signal into A/D Converter **IC9** (sheet 2 on schematic), alerts the user. If the monitor is not placed on AC MAINS power within approximately ten minutes, the software will turn the unit off. Should the software fail to turn the monitor off, the hardware cutoff, controlled by comparator **IC35A**, activates, turning the unit off.

Stable reference voltages for the analog circuitry are derived from **IC7** (sheet 1 on schematic), a precision 2.5V with low drift. Five Volt and 2.5 Volt references are generated by **IC8**.

Refer to Table 9.

Signal	Supply	Description
VDCIN	+10 - +15 VDC	Main DC input generated from offline switcher or internal battery
VBATT	+10 - +12.5VDC	Internal Battery DC input
VBACK	+2.5VDC or +5VDC	Supply for SRAMs, either VDD or 2.5V to maintain SRAM data during power down
VHTR	+12V or VBATT	Supply for the Capnostat Case and Detector heaters and Fan, regulated at 12V when MAINS power available or from VBATT when unit is on battery power
DISPVA	+12V or VBATT	Supply for the EL Display, regulated at 12V when MAINS power available or from VBATT when unit is on battery power
VDD	+5VDC	Regulated digital logic supply
VVDD	+5VDC	Regulated and filtered supply for the valves
CVDD	+5VDC	Regulated and filtered logic supply for CO_2 analog sub-system
DVDD	+5VDC	Regulated and filtered logic supply for general analog sub-systems
ADCVDD	+2.14VDC	ADC input for monitoring VDD
+VA	+14VDC (nominal)	Loosely regulated off of the 5VDC feedback line
+VSRC	+12VDC	Linearly Regulated and filtered positive supply for the Capnostat Source. Tracks -VSRC to provide a 24V +/- 2.5% differential voltage across the source

Table 9: Power Supply Outputs

ADCPVSRC	+0.85VDC	ADC input for monitoring +VSRC
-VSRC	-12VDC	Linearly Regulated and filtered negative supply for the Capnostat Source. Tracked by +VSRC to provide a 24V +/- 2.5% differential voltage across the source
ADCNVSRC	+0.75VDC	ADC input for monitoring -VSRC
-VA	-14VDC (nominal)	Loosely regulated off of the 5VDC feedback line
IRAW	+7.5VDC (nominal)	Loosely regulated off of the 5VDC feedback line, isolated from the other transformer windings
IVDD	+5VDC	Linearly Regulated to provide an isolated digital and analog power source

Table 9: Power Supply Outputs

3.3.6 Logic and Input / Output Signal Control

Refer to sheet 6 on 2764-03 schematic.

Chip selection for the serial peripherals are provided by decoders **IC43** and **IC46** and by the inverters **IC47**, **IC45E** and **IC45F**. Latch **IC41** is used mainly to control the system pneumatics, with Latch **IC42** providing additional control signals for the *NICO*® 2765-01 Analog Board. Input buffer **IC44** allows the digital system to read various status signals from the Analog Board.

3.4 Analog Board 2765-01

3.4.1 CAPNOSTAT Interface

Refer to sheet 1 on 2765-03 schematic.

A twenty pin connector, **J2**, interfaces the CAPNOSTAT with the system electronics. Ferrite filters have been placed on all lines to suppress radiated EMI and reduce susceptibility from high frequency external sources of interference.

Stable reference voltages for the sensors and analog circuitry are derived from **IC1**, a precision 2.5V reference with low drift. Five Volt and 2.5 Volt references for the CO_2 and Saturation circuits are generated by **IC2**. Positive and negative supply rails for the analog circuitry are derived from linear regulators **IC6**, **IC7** and **IC50**, while regulators **IC3** and **IC49** and provide regulated voltage supplies for the CAPNOSTAT itself.

3.4.2 CO_2 Input Signal Path

Refer to sheet 2 on 2765-03 schematic.

The signals from the sensor CO2DATAIN (CO_2 Data) and CO2REFIN (Reference Signal) have similar signal paths. The CO2DATAIN passes through a high pass filter with a gain of 7.65 consisting of **C60**, **R68** and buffer amplifier **IC15B**. The signal is fed to a Butterworth low pass filter **IC15A** and associated components. This filter has a gain of 2 with a corner frequency of 1.5 kHz. The output from the low pass filter is fed to a 12-bit Digital to Analog converter **IC14**. The signal, CO2DFB comes into the feedback pin of the DAC, which acts as a programmable gain stage. Here, under processor control, the signal's gain is adjusted to an acceptable level for conversion. The gain setting is adjusted using the digitized signal out of A/D Converter **IC4** (sheet 1 on schematic) as part of the feedback loop. Similarly, CO2REFIN is conditioned by high pass filter **IC16B** with a gain of 3.5 and low pass filter **IC16A** with a gain of 2. The

equivalent fixed gains for the two input signals are not equal in order to compensate for differences in the output signal levels of the infra-red detectors in the CAPNOSTAT.

The output from DAC **IC14** corresponding to signal CO2DATAIN is buffered by **IC12A** and AC coupled through **C49** to **IC11A**. The CO2DATA signal received from the CAPNOSTAT is AC coupled prior to the high pass filter to remove any DC bias by **C60**. Prior to sampling a CO_2 signal, the CO2AZ (Auto Zero) pulse turns **Q1** on causing any residual charge on **C49** to discharge to ground. At the start of the source pulse, the CO2AZ pulse goes Low and the CO_2 signal from the sensor is acquired. The signal is buffered by **IC11A** before appearing at the input of the sample and hold amplifier, **IC13A**. Near the end of the source pulse, the CO2SSH (CO_2 Sample and Hold) goes Low and the peak signal is acquired on the internal sample and hold capacitor. CO2SSH returns high at the end of the cycle, and the CO_2 signal on the sample capacitor is held at the peak value. The signal then passes through a low pass filter and resistive divider network consisting of **R51**, **R53** and **C51** before being converted by the A/D Converter **IC4** into digital data and analyzed by the processor. The signal CO2REF follows an identical zeroing and acquisition path.

3.4.3 CO_2 Case and Detector Heater Regulation

Refer to sheet 2 on 2765-03 schematic.

For the purpose of describing the regulation loop, the case heater circuitry will be considered. The detector and case heater circuitry are identical.

Inside the CAPNOSTAT, a sensing thermistor is thermally connected to the heater module. Initially, the CAPNOSTAT is at ambient temperature and the resistance of the thermistor is large. A small current flows through the signal path CASETHERM and only a small voltage is developed across **R47**. The microprocessor programs the TPU to allow an initial maximum duty cycle of 70% to power the PWM heater circuitry. This causes the heater control MOSFET on the *NICO*® 2764-01 Power Board to be pulsed on and off with a duty cycle that is under direct control of the program software. As the heater warms up the case, the thermistor's resistance decreases, raising the voltage appearing at the input of the control loop. As described below, the MPU looks at this output voltage and decreases the duty cycle of the PWM control circuitry, gradually reducing the power output into the heater. When the desired temperature set point is reached, a balance is struck between the energy delivered into the system and the heat flow out of the system.

The case thermistor is sensed by amplifier **IC9B**. The difference between the signal at the non-inverting input and the reference appearing at the inverting terminal generates an error voltage proportional to the sensed temperature at the amplifier's output:

e_o (V) = [83.133V / (R_{th}+3.32K)] - 10.2V where e_o = amplifier output voltage

R_{th} = resistance of the thermistor

= 4.36933K at 45°C

Temp (°C) = 4.1288 (°C/V) * $e_{o\,(T)}$ V + 41.7321°C

where e_o = amplifier output voltage at temperature T

This error voltage is low pass filtered by amplifier **IC8B**, sent to the ADC and processed by the CPU to regulate the output pulses from the TPU. The error voltage out of amplifier **IC9B** also appears at the temperature watchdog comparator **IC10A**. If the error voltage reaches approximately 56 degrees Celsius, the comparator trips, causing the output to go Low and turning off the heater supply on the Power Board.

3.4.4 Flow Zeroing and Patient Line Purging

Refer to sheet 5 on 2765-03 schematic.

The zero process begins when the CPU brings the VALVE1, VALVE2, VALVE3 VALVE4and VALVE6 lines high, energizing valves **V1**, **V2**, **V3, V4** and **V6**. This action disconnects the differential pressure transducer **IC18** (via **V1** and **V2)** and the absolute pressure transducer **IC29** (via **V2**) from the patient airway, shunts the differential pressure sensor ports (**V4**), and opens all pressure transducer ports to atmosphere through **V3**. Valve **V6** switches the pump output from the external *NICO*® Valve to the internal patient tubing and flow sensor. The differential pressure transducer is “zeroed” by capturing the digital output of the 20-bit sigma delta A/D Converter, **IC25** (sheet 3 on schematic), during this zero flow condition, and using this value to set the software. The patient airway pressure transducer is "zeroed" by adjusting the output of the DAC, **IC26** pin 10 (sheet 3 on schematic), until the Airway Pressure signal into the ADC, **IC4**, reads mid-scale. The barometric (ambient) pressure, as sensed by **IC28** (sheet 3 on schematic), is recorded after the airway pressure zero is completed. IC30 acts to filter the signals from the barometric pressure and airway pressure channels. After the result from each channel is stored in SRAM to be used as an offset in the flow and pressure calculations, valves **V1**, **V2**, **V3, V4** and **V6** are then de-energized, reconnecting the pressure transducers with the patient airway.

If patient line purging is enabled by the software, the system turns on the pump by bringing the PURGE line high after the zero values are recorded. A slight pressure is allowed to build in the pump tubing line that will aid in flushing out the patient airway tubing. To purge patient line 1, the CPU brings the VALVE1 and VALVE4 signals high, energizing Valves **V1** and **V4**. **V1** connects the pump with the P1 patient line, flushing out the patient P1 line while **V4** shunts across the differential pressure transducer, preventing a differential pressure from appearing across the transducer. During purging, the system is able to monitor the pressure that is present in the selected patient line by reading the AWPRESS signal. VALVE1 is brought low and **V1** is the de-energized, once again isolating the pump from the patient airway and allowing a pressure head to build once more. The VALVE2 line is then brought high and valve **V2** is then energized, flushing out the patient P2 line. After all lines have been flushed out, **V1** and **V3** are re-engerized allowing any residual pressure to be vented to atmosphere. All valves are then de-engerized and the PURGE signal is brought low, turning the pump off. The purging process is complete and normal patient monitoring continues.

A hardware watchdog, consisting of **IC44A** and the surrounding circuitry, limits the maximum pump-on time, preventing overpressure from building in the patient lines.

3.4.5 Flow Circuitry

Refer to sheet 3 on 2765-03 schematic.

Differential Pressure Transducer, **IC18**, is a silicon based, piezoresistive bridge with four active elements. When a pressure is applied between transducer ports P1 and P2, a differential output voltage proportional to the applied pressure is produced. The full-scale output range for the transducer is 0 to 10 inches of water (P1>P2). By setting the 0 differential pressure (no-flow) point to mid-scale (during the zeroing process described earlier), negative pressure readings (P2>P1) are also available. The transducer is temperature compensated at 25 degrees Celsius and designed to be driven by a constant voltage source.

In the normal system operating mode, all valves are de-engerized and the pump is inactive. Transducer ports P1 and P2 are connected to the patient airway. As air flows through the airway adapter pneumotach, a pressure difference between P1 and P2 is

created. This signal is dependent on both the magnitude and the direction of the airflow. The greater the flow volume, the larger the pressure difference created between the two transducer ports. The transducer senses an inspired flow as a positive pressure difference (P1>P2), while an expiratory flow is seen as a negative pressure (P2>P1). With a supply voltage of 2.5V, the sensor transforms this pressure difference into an electrical signal with a nominal absolute magnitude of 23 mV Full-scale Output. This signal is conditioned and amplified by **IC23**, which is a monolithic Instrumentation Amplifier (IA). A positive pressure difference (inspiratory flow) creates a signal above the no-flow zero baseline obtained during the zeroing process. A negative pressure difference (expiratory flow) is below the set baseline. The nominal gain of **IC23** is set by fixed resistors **R85**, **R83** and variable resistor **VR1**. The output for the transducer is adjusted using **VR1** and a known pressure input as a calibration reference. With an input differential pressure of 20 cmH_2O, the gain of the amplifier is set to give an ADC count of 412160.

The signal out of the flow IA is taken through a two-pole low pass filter **IC22A** with a 31 Hz cutoff frequency to remove unwanted high frequency electronic noise. It is then passed on to the 20-bit sigma delta ADC, where it is transformed from an analog voltage into a digital code for processing by the CPU, located on the 2763-01 Digital Board.

3.4.6 Barometric and Airway Pressure

Refer to sheet 3 on 2765-03 schematic.

IC29 is a piezoresistive differential pressure transducer with port P2 held at zero psi. It measures the absolute pressure difference at port P1 relative to the vacuum at port P2. The transducer is calibrated for a full scale output of 0 to 15 psi, has internal temperature compensation, and is designed to be driven by a constant voltage source. Instrumentation amplifier (IA) **IC28** conditions this signal to correspond to the current barometric pressure, which is set by adjusting **VR3**. The nominal gain of this amplifier is 67, which corresponds to a 12-bit ADC count of 4012 at 760 mmHg. The output signal from **IC28** is low pass filtered by **IC30B** and appears as an input to both the 12-bit ADC and a second IA, **IC27**. **IC27** provides gain adjustment via **VR2** and offsets the output signal from the barometric amplifier to mid-scale during the zeroing state. The nominal gain of the airway pressure amplifier is 5. This signal connects to the P1 (proximal to the patient) side of the differential pressure transducer during monitoring and provides patient airway pressure sensing.

3.4.7 Patient Airway Adapter Type Sensing

Refer to sheet 5 on 2765-03 schematic.

Given a specific flow sensor type (i.e., Adult), the physical characteristics of the sensor will be consistent from one adapter to another. However, due to the differences in the physical size and geometry of the various flow sensor types, each type (i.e., Adult, Adult Combo) requires different coefficients be used in the calculation of flow. Each flow sensor type has a unique 4-bit code associated with it. This pattern molded into the connector body can be optically reflective or non-reflective and is read by the system. A pulse is generated by the CPU that turns on the LED component of a opto-coupler mounted directly beneath each pattern segment. If the pattern segment associated with that opto-coupler is reflective, the LED's light will cause its photodetector mate to be turned on, which generates a signal that is sensed by the system and relayed back to the CPU. If the segment is non-reflective, no signal is returned to the sensing circuitry. A four-bit code can generate 16 unique pattern combinations. One code condition, all zeros (no reflection), is reserved for detecting when the sensor unplugged. The circuitry to decode the flow sensor type consists chiefly of connector J5 and comparator IC40.

3.4.8 NICO® Sensor Rebreathing Valve Control

Refer to sheets 3 and 5 on 2765-03 schematic.

To initiate a *NICO*® cycle and switch the external *NICO*® Valve from non-rebreathing to rebreathing mode, valve **V5** is energized, which switches the tubing to the external valve from atmosphere to the pump. The pump is turned on, causing the diaphragm in the *NICO*® valve to switch to rebreathing mode. The pressure in the airline is monitored by pressure transducer **IC32** and IA **IC31**. When adequate pressure to switch the valve is reached, the pump turns off and the software continues to monitor the airline pressure to ensure pressure is maintained. Valve **V6** has a time-out watchdog, **IC44B**, to ensure that software control over the external *NICO*® valve is maintained.

3.4.9 Saturation Input Signal Path and Signal Conversion

Refer to sheet 4 on 2765-03 schematic.

On power up, the system performs a self-calibration cycle to establish the level of background circuit offset. Calibration is performed by coordinating the control signals SPO2CAL, SPO2SC1, ASAMPL, RSAMPL, ISAMPL, SIGNDL and INSIGL. Once the system baseline has been acquired, the Red and Infrared ADCs, **IC33** and **IC37**, adjust their output to compensate for any system offsets found. Since the LED drives are staggered, a single detector is used to multiplex the individual signals on a common signal input line. Amplifier **IC36B** performs a current to voltage conversion on the input signal, and analog switch **IC35** steers the signal to the proper 20-bit ADC based upon the LED channel (Red or Infrared) that is currently active. A sample and hold circuit for each channel made up of **IC35** and **IC34** transform the pulsed input signal into a constant voltage level for signal conversion. The main timing signal generation for saturation signal acquisition is generated by the TPU. Amplifier **IC38A** generates an analog signal, SPO2PROB, that varies with the saturation probe type. SPO2PROB is converted to digital form by ADC **IC9** on the *NICO*® 2763-01 Digital Board Schematic.

4 Functional Testing

The functional Testing verifies overall functional integrity of the monitor and sensors. If the Model 7300 does not pass these tests, remove from use and contact the Novametrix Service Department for repair/replacement assistance.

This procedure assumes the technician performs each step as indicated - leaving the monitor in a known state prior to performing the next step. If steps are omitted or performed out of order, be sure that the monitor is set to the correct state before continuing.

4.1 Equipment Required

1. CAPNOSTAT CO_2 Sensor, PN: 9567-00
2. NICO® sensor, standard, PN: 8951-01
3. SpO_2 Finger Sensor, PN: 8776-00
4. 500ml Calibration syringe, Hans Rudolph Model 5550 or equivalent
5. Model 1298 Gas Calibrator, PN: 6081-00
   Low point calibration gas, PN: 8364
   Adult airway adapter PN: 7007-01 Qty. 3

4.2 Functional Test

In this procedure the term “select” refers to highlighting a selection on the screen by turning the knob, then pressing it in to select the highlighted option.

1. Connect the monitor to the AC line. Set the rear panel power entry module switch ON. Verify the AC LED turns on.
2. Press the power switch. Verify the display shows the NICO® start up routine followed by the main display screen (reference the Users Manual for display appearance).
3. Connect the NICO® sensor to the monitor. Verify an STANDARD NICO® SENSOR IDENTIFIED message is momentarily displayed.
4. Connect the CAPNOSTAT CO_2 sensor to the monitor. Verify the CO_2 SENSOR? message is replaced by a WARMUP message.
5. Place the CAPNOSTAT CO_2 sensor on the NICO® sensor airway adapter.
6. Press the MENU button. Verify the SELECT A SCREEN menu is displayed.
7. Select the SETUP screen.
8. Select CO_2 ZERO NOW. Follow the screen prompts to perform an airway zero. When the zeroing is complete, select EXIT.

NOTE: The CAPNOSTAT CO_2 sensor must reach operating temperature before zeroing.

9. Connect the low point calibration gas to the Model 1298 Gas Calibrator. Refer to the instructions supplied with the gas calibrator for further instructions.
10. Connect the Model 1298 Gas Calibrator with low point calibration gas to the NICO® sensor via the airway adapter stack (see instructions with Model 1298 Gas Calibrator).
11. Press and hold the MENU and DATA ENTRY keys simultaneously until the CONFIGURATION MENU appears. Select DIAGNOSTIC SCREENS, then select CO_2.
12. Flow gas for thirty seconds. Verify the CO_2 value as determined from “Determining Torr Value” on page 27.
13. Turn the calibration gas off. Select EXIT and remove the Model 1298 Gas Calibrator.
14. Select CO_2/SpO_2.
15. Breathe into the NICO® sensor, verify both $ETCO_2$ and RR values.
16. Stop breathing into the NICO® sensor. Wait for 20 seconds, verify that an alert is generated and NO RESP: X:XX is displayed where X:XX starts at 0:20 and counts up in seconds. Press SILENCE to reset any audible alerts.
17. Turn the knob until the FLOW/PRESSURE screen is displayed.
18. Connect the 500 ml calibration syringe to the NICO® sensor. Pump the syringe back and forth at a rate of 15 cycles per minute. Verify a Vti and Vte of 500ml ± 25.
19. Remove the calibration syringe.
20. Press the MENU button. Select SET ALERTS. Verify the SET ALERTS screen is displayed.
21. Select the low pulse (bpm) alert. Verify the ENTER LOW PULSE LIMIT screen is displayed.
22. Record the current value of the low pulse limit. Follow the screen instructions and set the low pulse limit to 99. Verify that the bell icon next to the limit is active (does not have a line through it). If not select it to enable audible alerts.
23. Select the AUDIO. Follow the screen instructions and scroll through the audio levels. Verify the audio increments with each audio level. Set the audio level to 5.
24. EXIT the SET ALERTS screen.
25. Turn the knob until the CO_2/SPO2 screen is displayed.
26. Connect the finger sensor to the monitor. Verify the SPO_2 PROBE? message is replaced by a PULSE SEARCH message.
27. Place the SpO_2 finger sensor on your finger. Verify an SpO_2, pulse rate and pleth waveform are present. Verify the pulse value is blinking, LOW PULSE is displayed, and an audio alert is heard.
    Note:If your pulse is not below 99 you will not get the error.
28. Press the SILENCE button. Verify the audio alert is silenced and the SILENCE button is flashing between yellow and red.
29. Remove the finger sensor from your finger. Verify a PULSE SEARCH message is displayed.
30. Follow steps 20. 21. and 22. to return the low pulse limit to the previous value.

31. Press the MENU button, select SETUP. Verify the SETUP screen is displayed.
32. Select SET TIME & DATE. Verify the time and date are correct.
33. Exit the SET TIME & DATE screen then EXIT the SETUP screen.
34. Set the power entry module switch on the rear panel to the OFF position. Verify the AC indicator turns off, a battery icon is displayed and the monitor continues to operate. Set the power entry module switch back ON.
35. The test is complete. Disconnect the sensors from the monitor and turn it off.

4.3 Determining Torr Value

Use the attached tables to determine the nominal torr value for the calibration gas in use. The gas temperature and the barometric pressure affect the nominal torr value.

1. Get the current barometric pressure from a calibrated barometer.
2. Get the current gas temperature (room temperature is adequate provided the gas has had time to acclimate).
3. Find the nominal torr value by locating the current barometric pressure in the first column then go across until the correct temperature column intersects. The corresponding number is the nominal torr value. The “SIM” column is the column used if a TB1265 Sensor Simulator, PN: 5776-00 is used in place of gas.
4. Use the nominal torr value as the base number when performing CO2 gas measurements. The tolerance for the CO2 gas value is the base number ± 2 for 5% gas.
   Monitor default O2 compensation % = 40
   Test gas O2 concentration percentage = 0

Baro. Press. mmHg	Gas Temperature (°C)							
	21	22	23	24	25	26	27	Sim
735	39.4	39.3	39.2	39.1	39.0	38.8	38.7	40.2
736	39.5	39.4	39.3	39.1	39.0	38.9	38.8	40.2
737	39.5	39.4	39.3	39.2	39.1	38.9	38.8	40.1
738	39.6	39.5	39.4	39.2	39.1	39.0	38.9	40.1
739	39.7	39.5	39.4	39.3	39.2	39.0	38.9	40.0
740	39.7	39.6	39.5	39.3	39.2	39.1	39.0	40.0
741	39.8	39.6	39.5	39.4	39.3	39.2	39.0	40.0
742	39.8	39.7	39.6	39.4	39.3	39.2	39.1	39.9
743	39.9	39.7	39.6	39.5	39.4	39.3	39.1	39.9
744	39.9	39.8	39.7	39.6	39.4	39.3	39.2	39.9
745	40.0	39.9	39.7	39.6	39.5	39.4	39.2	39.8
746	40.0	39.9	39.8	39.7	39.5	39.4	39.3	39.8
747	40.1	40.0	39.8	39.7	39.6	39.5	39.4	39.8
748	40.1	40.0	39.9	39.8	39.6	39.5	39.4	39.7
749	40.2	40.1	39.9	39.8	39.7	39.6	39.5	39.7
750	40.2	40.1	40.0	39.9	39.8	39.6	39.5	39.7
751	40.3	40.2	40.1	39.9	39.8	39.7	39.6	39.6

752	40.4	40.2	40.1	40.0	39.9	39.7	39.6	39.6
753	40.4	40.3	40.2	40.0	39.9	39.8	39.7	39.6
754	40.5	40.3	40.2	40.1	40.0	39.8	39.7	39.5
755	40.5	40.4	40.3	40.1	40.0	39.9	39.8	39.5
756	40.6	40.4	40.3	40.2	40.1	39.9	39.8	39.5
757	40.6	40.5	40.4	40.2	40.1	40.0	39.9	39.4
758	40.7	40.5	40.4	40.3	40.2	40.1	39.9	39.4
759	40.7	40.6	40.5	40.4	40.2	40.1	40.0	39.3
760	40.8	40.7	40.5	40.4	40.3	40.2	40.0	39.3
761	40.8	40.7	40.6	40.5	40.3	40.2	40.1	39.3
762	40.9	40.8	40.6	40.5	40.4	40.3	40.1	39.2
763	40.9	40.8	40.7	40.6	40.4	40.3	40.2	39.2
764	41.0	40.9	40.7	40.6	40.5	40.4	40.2	39.2
765	41.1	40.9	40.8	40.7	40.5	40.4	40.3	39.1
766	41.1	41.0	40.9	40.7	40.6	40.5	40.4	39.1
767	41.2	41.0	40.9	40.8	40.7	40.5	40.4	39.1
768	41.2	41.1	41.0	40.8	40.7	40.6	40.5	39.0
769	41.3	41.1	41.0	40.9	40.8	40.6	40.5	39.0
770	41.3	41.2	41.1	40.9	40.8	40.7	40.6	39.0
771	41.4	41.2	41.1	41.0	40.9	40.7	40.6	38.9
772	41.4	41.3	41.2	41.0	40.9	40.8	40.7	38.9
773	41.5	41.4	41.2	41.1	41.0	40.8	40.7	38.9
774	41.5	41.4	41.3	41.2	41.0	40.9	40.8	38.8
775	41.6	41.5	41.3	41.2	41.1	41.0	40.8	38.8
776	41.6	41.5	41.4	41.3	41.1	41.0	40.9	38.8
777	41.7	41.6	41.4	41.3	41.2	41.1	40.9	38.7
778	41.7	41.6	41.5	41.4	41.2	41.1	41.0	38.7
779	41.8	41.7	41.5	41.4	41.3	41.2	41.0	38.6

If the barometric pressure, gas temperature, monitor default compensations, or the O2 concentration in the test gas differs from the values listed in the table then use the formula below to calculate the nominal torr value.

(CO2 Gas %) * (Barometric Pressure) * (Gas Compensation) * (Pressure Compensation) / 1 - (0.003 * (33 - Gas Temperature))

The *gas compensation* factor if only O2 gas is present:

0.000865 * (Default O2 Compensation - Gas O2 Concentration) + 1

The *gas compensation* factor if O2 and N2O gas is present:

0.00249133 * (Default O2 Compensation - Gas O2 Concentration) + 1

If a TB1265 Sensor Simulator, PN: 5776-00 is used, the temperature compensation portion of the formula is not used. Divide the numerator by one.

The pressure compensation factor is calculated by linear interpolation into the PBCV table below. Take the current barometric pressure and locate the high and low values from the Pressure column in the table below (e.g. a barometric pressure of 752 would give a *Pressure Max* of 760 and a *Pressure Min* of 720). Calculate the rise over run or slope (m) for the range that the barometric pressure falls under. Determine the

difference between the barometric pressure and the lesser pressure value and multiply that by the slope then add one.

The formula for pressure compensation is:

PBCV for pressure min + (m * (Barometric Pressure - Pressure Min)) + 1

Where:

$$m = \frac{\text{(PBCV for pressure max - PBCV for pressure min)}}{\text{(Pressure Max - Pressure Min)}}$$

Pressure Table:

Pressure (mmHg)	**PBCV**
800	-0.0321
760	0.0000
720	0.0356
680	0.0754
640	0.1202
600	0.1710
560	0.2290
520	0.2959
480	0.3741
440	0.4662
400	0.5770

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5 Accuracy Tests

The Accuracy Tests verifies the performance accuracy of the Model 7300. This test is typically performed in conjunction with (after) the Functional Tests. If the monitor does not pass the Accuracy Tests, remove from use and contact the Novametrix Service Department for repair/replacement assistance.

This procedure assumes the technician performs each step as indicated - leaving the monitor in a known state prior to performing the next step. If steps are omitted or performed out of order, be sure that the monitor is set to the correct state before continuing.

5.1 Equipment Required

1. Leak test adapter, PN: 9695-48
2. Calibrated barometer
3. Capnostat CO_2 Sensor, PN: 9567-00
4. Model 1298 Gas Calibrator Catalog No. 6081-00
   Low point calibration gas, Catalog No. 8364
   Adult airway adapter PN: 7007-01 Qty. 3
5. TB500B Saturation simulator, PN: 5530-00
6. SpO_2 Finger Sensor, PN: 8776-00
7. NICO® sensor, PN: 8951-01
8. 500ml Calibration syringe, Hans Rudolph Model 5550 or equivalent

5.2 CO_2 Testing

In this procedure the term “select” refers to highlighting a selection on the screen by turning the knob, then pressing it in to select the highlighted option.

1. Connect the monitor to the AC line. Set the rear panel power entry module switch ON. Verify the AC LED turns on.
2. Press the power switch. Verify the display shows the NICO® start up routine followed by the main display screen (reference the Users Manual for display appearance).
3. Connect the NICO® sensor to the monitor. Verify an STANDARD NICO® SENSOR IDENTIFIED message is momentarily displayed.
4. Connect the CAPNOSTAT CO_2 sensor to the monitor. Verify the CO_2 SENSOR? message is replaced by a WARMUP message.
5. Place the CAPNOSTAT CO_2 sensor on the NICO® sensor airway adapter.

6. Press the MENU button. Verify the SELECT A SCREEN menu is displayed.
7. Select the SETUP screen.
8. Select CO_2 ZERO NOW. Follow the screen prompts to perform an airway zero. When the zeroing is complete, select EXIT.
   NOTE: The CAPNOSTAT CO_2 sensor must reach operating temperature before zeroing.
9. Connect the Model 1298 Gas Calibrator with low point calibration gas to the NICO® sensor via the airway adapter stack (see instructions with Model 1298 Gas Calibrator).
10. Press and hold the MENU and DATA ENTRY keys simultaneously until the CONFIGURATION MENU appears. Select DIAGNOSTIC SCREENS, then select CO2.
11. Flow gas for thirty seconds. Verify a CO_2 reading as determined from “Determining Torr Value” on page 27.
12. Shut the gas flow off. Remove the Model 1298 Gas Calibrator.
13. Verify the following displayed parameters:

SRC CUR	180-300
DET T	45.00 ± 0.2
CASE T	45.00 ± 0.2
DATA CHAN	3400 ± 200
REF CHAN	3400 ± 200

5.3 SpO_2 Testing

14. Select SPO_2 from the CO2 DIAGNOSTIC SCREEN.
15. Verify the STATUS: is “9 Probe Disconnect”.
16. Set the controls on the TB500B as follows:
    SENSOR TYPE: 87XX
    SIGNAL ATTENUATION:3
    SATURATION SETTING:100
    POWER:ON
17. Connect the TB500B to the monitor.
18. Set the saturation switch on the TB500B to “0”. Verify the status is “2 LOW SIGNAL”.
19. Set the saturation switch on the TB500B to “100”. Verify the status returns to “1 NO ERROR”.
20. Turn the TB500B OFF. Verify the status line reads “3 LOW LIGHT”.
21. Turn the TB500B ON. Verify the status returns to “1 NO ERROR”.
22. Press and hold the RED open test button on the TB500B. Verify the status is “13 RED LED FAIL”.
23. Release the RED open test button. Verify the status returns to “1 NO ERROR”.
24. Press and hold the INFRARED open test button on the TB500B. Verify the status is “12 IR LED FAIL”.

25. Release the INFRARED open test button. Verify the status returns to “1 NO ERROR”.
26. EXIT the diagnostic screen.
27. Select CO_2/SpO_2 in the SELECT A SCREEN menu.
28. Verify the Saturation and Pulse values for the following TB500B Saturation settings. Verify the pleth waveform is consistent and free of noise.

Test Box Switch Settings		Saturation
Saturation Setting	Signal Attenuation	Tolerance Range
100	3	98 - 100
82	3	80 - 84
62	3	60 - 64
72	7	68 - 76
92	7	88 - 96

Verify Pulse rate is 60 ± 1 for all settings

29. Disconnect the TB500B from the unit and turn it OFF.

5.4 Flow Testing

30. Turn the knob until the FLOW/PRESSURE screen is displayed.
31. Connect the 500ml calibration syringe to the NICO® sensor.
32. Pump the calibration syringe back and forth with a steady motion at a rate of 20 cycles per minute. Verify the Vte and Vti are 500 ± 25.
33. Disconnect the 500ml calibration syringe from the NICO® sensor.
34. Press and hold the MENU and DATA ENTRY keys simultaneously until the CONFIGURATION MENU appears. Select DIAGNOSTIC SCREENS, then select FLOW.
35. Connect the 9695-48 Leak Test Adapter to the unit.
36. Pull the syringe back.
37. Set the stop cock open.
38. Push in the syringe until the airway pressure (Paw) reads 100 cmH_2O.
39. Close the stop cock.
40. Verify the pressure remains above 90 cmH_2O after 30 seconds.

5.5 Time / Date Setting

41. Press the Menu button. Verify the select a screen menu is displayed.
42. Select the setup screen. Verify the setup screen is displayed.
43. Select SET TIME & DATE option. Follow the instructions and set the correct time and date. Exit the SET TIME & DATE screen then exit the setup screen.

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6 Electronic Tests

The Electronic Tests verify the calibration and operation of the electronic circuits within the Model 7300. These tests DO NOT need to be performed on a regular (preventative) basis. Perform these tests only if the monitor fails to operate as expected or fails the Accuracy Tests or the Functional Tests. The Electronic Tests should be performed only by qualified service personnel.

The Electronic Tests require access to the internal components of the monitor. Refer to the Maintenance section for disassembly instructions.

CAUTION: The Model 7300 contains static sensitive devices. Be sure to follow proper grounding procedures when handling the internal components to avoid damage from static discharge.

WARNING: Electrical shock hazard, internal assemblies contain high voltage, refer servicing to qualified service personnel.

This procedure assumes the technician performs each step as indicated - leaving the monitor in a known state prior to performing the next step. If steps are omitted or performed out of order, be sure that the monitor is set to the correct state before continuing.

6.1 Equipment Required

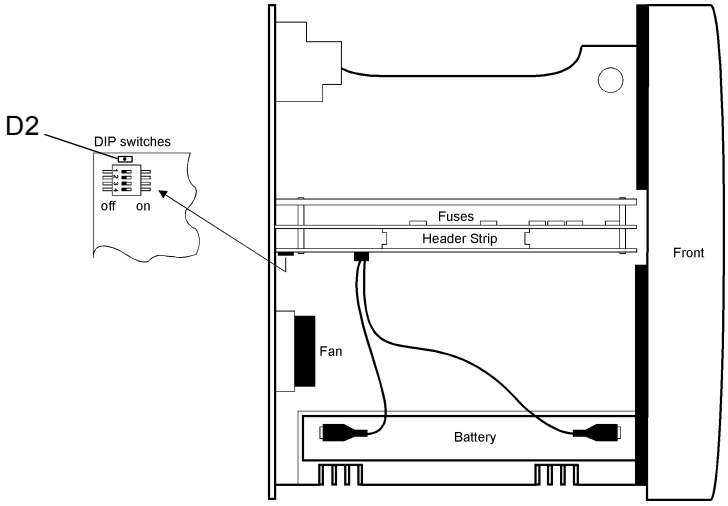
1. TB1265 Sensor Simulator, PN: 5776-00
   The Novametrix TB1265 Sensor Simulator emulates a functioning CAPNOSTAT CO_2 Sensor, and can be used in place of the CAPNOSTAT CO_2 Sensor for monitor test purposes. The TB1265 will verify the functionality of the monitor's CO_2 front end circuitry. Certain error conditions can be simulated to verify responses from the monitor under test.
   The TB1265 is an optional test device and is not mandatory for testing the Model 7300. Its purpose is to increase test efficiency by simulating a working CAPNOSTAT. The TB1265 Sensor Simulator is available from Novametrix Service Department.
2. TB1265 Adapter cable, PN: 5776-48
3. Current limit test jack, PN: 5693-48
4. TB500B Saturation simulator, PN: 5530-00
5. Optical encoder "5" test jack, PN: 9635-48
6. Optical encoder "A" test jack, PN: 9635-14
7. Pressure source, Penwalt pneumatic calibrator model 65-120 or equivalent
8. Common mode test jack, PN: 9638-48
9. Differential test jack, PN: 9636-48

10. Plug test fixture, PN: 9645-48
11. Shorted saturation test jack, PN: 6573-48
12. Oscilloscope
13. 30 ohm 10 watt resistor
14. 100 ohm 2 watt resistor
15. Digital Volt Meter (DVM)
16. Leakage Tester

6.2 Power Supply

In this procedure the term “select” refers to highlighting a selection on the screen by turning the knob, then pressing it in to select the highlighted option.

1. Set switches 2 and 3 on S1 on the 2763-01 board to the “ON” position.
2. Connect the monitor to the AC line. Set the rear panel power entry module switch ON. Verify the AC LED turns on.
3. Press the power switch. Verify the display shows the NICO® start up routine followed by the main display screen. Verify the red LED (D2) on the 2763-01 board flashes and “PRODUCTION TEST” is displayed in the message area.

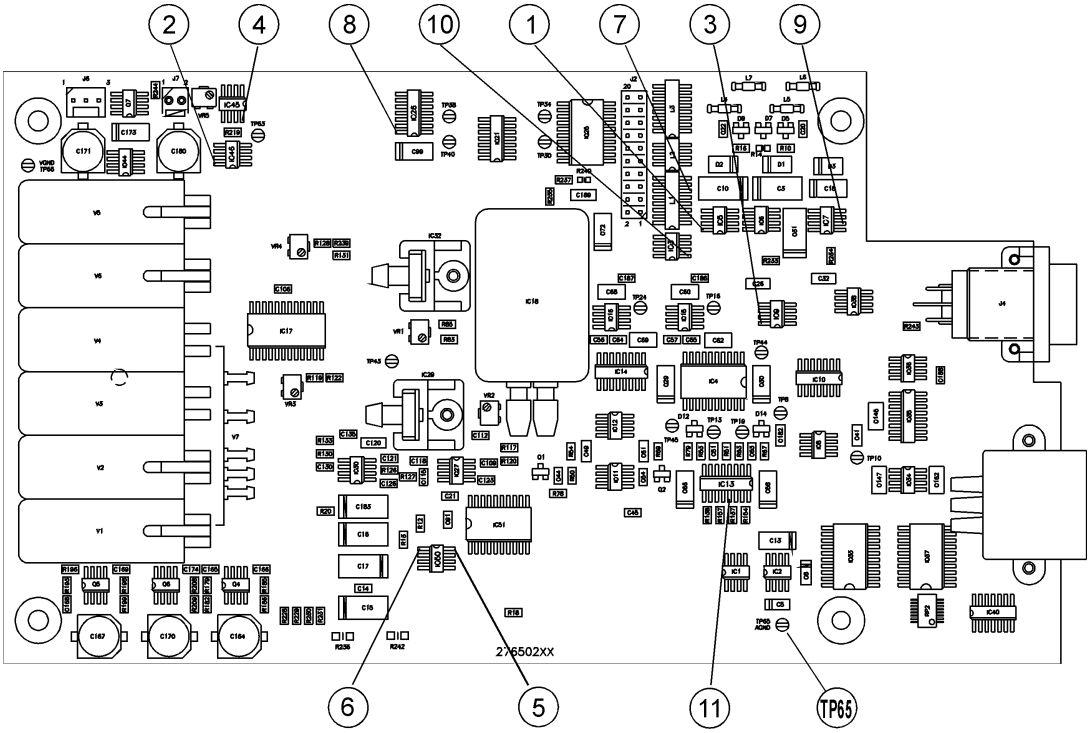


4. Using a DVM, measure the power supply voltage at J6 pin 1 on the 2764-01 board (Use TP1 on the 2763-01 board for ground reference). Verify 15.00V ± 1V.
5. Disconnect the connectors from the battery terminals. Measure the voltage at the positive battery terminal connector. Verify 13.5V ± 600mV.
6. Connect the 100 ohm resistor across the battery terminal connectors from J7. Measure the voltage and verify 13.77V ± 500mV. Remove the resistor.
7. Connect the 30 ohm resistor across the battery terminal connectors from J7. Using an oscilloscope, verify pulses present, the peak of the pulses should not be higher than 13.77V ± 500mV.
8. Disconnect the resistor. Position the battery cables from J7 in such a manner so that they do not short against anything.

6.3 Voltage Checks

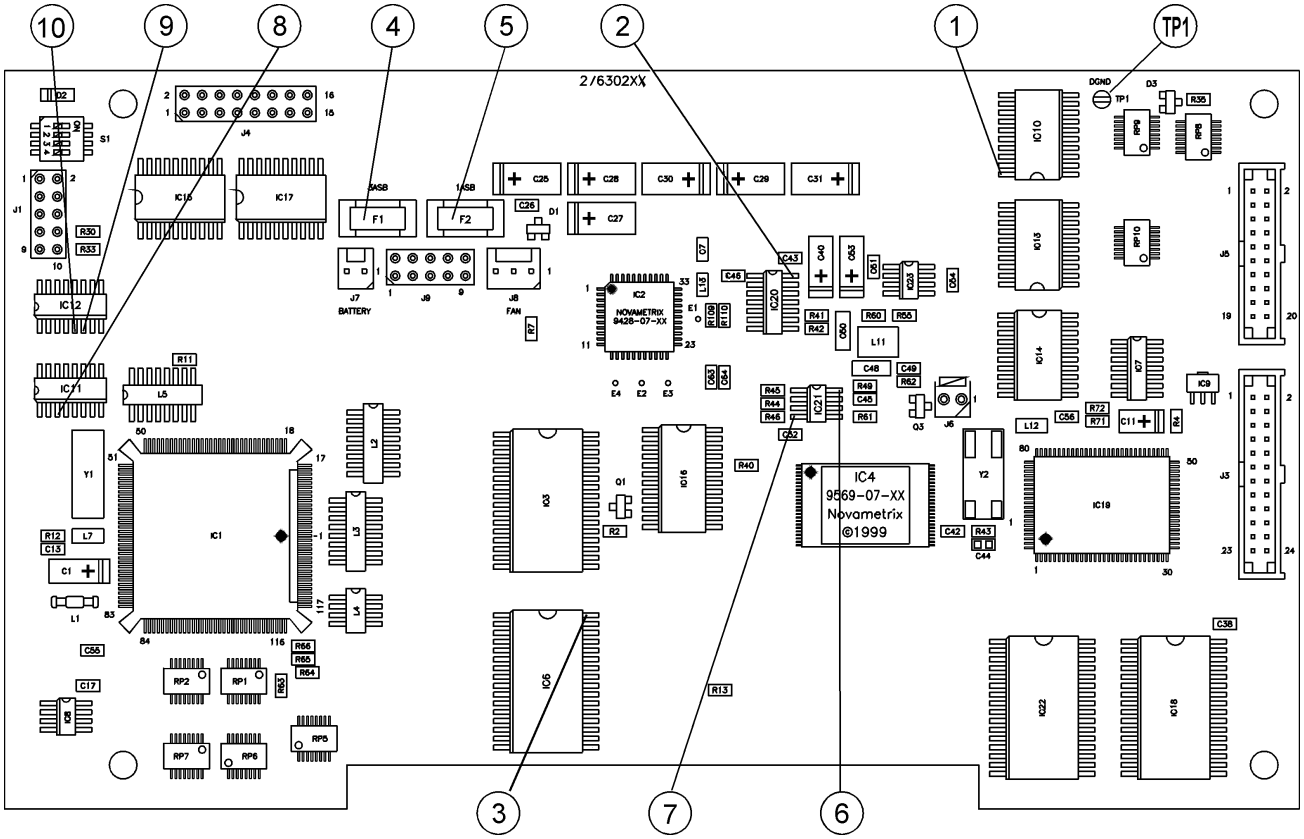
9. Use TP65 on the 2765 board as ground reference for all measurements unless otherwise specified. Measure the following power supply voltages using a DVM:

	Supply Name	Location	Voltage Range
1	VDD	IC5 pin 8	5.00V ± 150mV
2	VVDD	IC46 pin 8	5.00V ± 150mV
3	CVDD	IC9 pin 8	5.00V ± 150mV
4	DISPVA	IC45 pin 8	12.15V ± 500mV
5	AVCCIN	IC50 pin 8	16.00V ± 2.50V
6	AVCC	IC50 pin 1	12.00V ± 500mV
7	VCAPNO	L1 pin 6	12.00V ± 500mV
8	FVDD	IC26 pin 14	5.00V ± 200mV
9	-VA	IC7 pin 2	-16.00V ± 2.50V
10	-VCAPNO	IC3 pin 1	-12.00V ± 500mV
11	-AVCC	IC13 pin 13	-5.00V ± 250mV



10. Measure the following voltages on the 2763 board with a DVM, use TP1 as ground reference.

	Supply Name	Location	Voltage Range
1	VDD	IC10 pin 20	5.00V ± 150mV
2	DVDD	IC20 pin 14	5.00V ± 150mV
3	VBACK	IC6 pin 32	4.50V ± 250mV
4	VBATT	F1	12.60V ± 500mV
5	VHTR	F2	12.15V ± 500mV
6	+VA	IC21 pin 8	16.50V ± 2.50V
7	-VA	IC21 pin 4	-16.50V ± 2.50V



6.4 CO_2 Testing

11. Set the TB1265 switches as follows:
    INSPIRED CO2: OFF
    %CO2: 0
    SENSOR LOCATION: A/A
    SOURCE CURRENT: NORMAL
    CO2 MODE: CONTINUOUS
    TEMPERATURE: NORMAL
12. Connect the TB1265 to the monitor using the TB1265 adapter cable.
13. Press the MENU key, then select SETUP.
14. Select CO_2 ZERO NOW. Follow the screen prompts to perform an airway zero. When the zeroing is complete, select EXIT.
    NOTE: The CAPNOSTAT CO_2 sensor simulator must reach operating temperature before zeroing.
15. Set the TB1265 simulator controls as follows:
    CO2 MODE: RESPIRATION
    %CO2: 5%
16. Turn the knob to display the CO_2/SPO_2 screen and verify an $ETCO_2$ value as determined from “Determining Torr Value” on page 27, and a RR (respiration rate) of 20 ± 2.
17. Press and hold the MENU and DATA ENTRY keys simultaneously until the CONFIGURATION MENU appears. Select DIAGNOSTIC SCREENS, then select CO2.
18. Verify DET T and CASE T stabilize at 45.00 ± 0.2.
19. Use TP65 as reference and monitor L5 on the 2765 board. Set the TB1265 TEMPERATURE to CASE OVERTEMP. Verify the voltage is at zero volts and CASE T is >50.00 and DET T remains at 45.00 ± 0.2
20. Set the TEMPERATURE back to NORMAL. Verify CASE T stabilizes at 45.00 ± 0.2 within 2 minutes.
21. Monitor L4 on the 2765 board. Set the TB1265 TEMPERATURE to DETECTOR OVERTEMP. Verify the voltage is at zero volts and DET T is > 50.00 and CASE T slowly drops to 42.00 degrees.
22. Set the TEMPERATURE back to NORMAL. Verify DET T stabilizes at 45.00 ± 0.2 within 2 minutes.
23. Verify the SRC CUR is between 240 and 280.
24. Set the TB1265 SOURCE CURRENT to HIGH. Verify the SRC CUR slowly increases to a value > 340 and the CASE T and DET T are < 42.00.
25. Set the SOURCE CURRENT back to NORMAL. Verify SRC CUR is between 240 and 280 and CASE T and DET T slowly rise and stabilize at 45.00 ± 0.20 within two minutes.
26. Disconnect the TB1265 from the monitor.

6.5 SpO_2 Testing

27. Select SpO_2 from the CO2 DIAGNOSTIC SCREEN.
28. Connect the current limit test jack to the monitor. Verify the LED on the fixture is on.
29. Press the switch on the current limit test jack. Verify the red LED turns off.
30. Remove the current limit test jack.
31. Verify the STATUS is “9 Probe Disconnect”.
32. Set the controls on the TB500B as follows:
    SENSOR TYPE: 87XX
    SIGNAL ATTENUATION: 3
    SATURATION SETTING: 100
    POWER: ON
33. Connect the TB500B to the monitor.
34. Set the saturation switch on the TB500B to “0”. Verify the status is “2 LOW SIGNAL”.
35. Set the saturation switch on the TB500B to “100”. Verify the status returns to “1 NO ERROR”.
36. Turn the TB500B OFF. Verify the status line reads “3 LOW LIGHT”.
37. Turn the TB500B ON. Verify the status returns to “1 NO ERROR”.
38. Press and hold the RED open test button on the TB500B. Verify the status is “13 RED LED FAIL”.
39. Release the RED open test button. Verify the status returns to “1 NO ERROR”.
40. Press and hold the INFRARED open test button on the TB500B. Verify the status is “12 IR LED FAIL”.
41. Release the INFRARED open test button. Verify the status returns to “1 NO ERROR”.
42. EXIT the diagnostic screen.
43. Select CO_2/SpO_2 in the SELECT A SCREEN menu.
44. Verify the Saturation and Pulse values for the following TB500B Saturation settings. Verify the pleth waveform is consistent and free of noise.

Test Box Switch Settings		Saturation
Saturation Setting	Signal Attenuation	Tolerance Range
100	3	98 - 100
82	3	80 - 84
62	3	60 - 64
72	7	68 - 76
92	7	88 - 96

    Verify Pulse rate is 60 ± 1 for all settings

45. Disconnect the TB500B from the unit and set POWER: OFF.

6.6 Flow, Barometric Pressure and Rebreathe Valve Testing

46. Press and hold the MENU and DATA ENTRY keys simultaneously until the CONFIGURATION MENU appears. Select DIAGNOSTIC SCREENS, then select FLOW.
47. Verify SENSOR is “(0) UNPLUGGED”.
48. Connect the “5” test jack to the monitor. Verify “(5) Not Used” is displayed.
49. Connect the “A” test jack to the monitor. Verify “(10) 9766-01 Ped.Flow/CO2” is displayed.
50. Record the current barometric pressure from the calibrated barometer.
51. Adjust VR3 on the 2765 board if necessary until the TOT PRESS equals the current barometric pressure.
52. Select ZERO. Verify the BARO PRESS equals the value from the previous step. Readjust VR3 if necessary.
53. Connect the NICO® sensor to the monitor. Select REBREATHE.
54. Verify the pump starts and the PRESS2 rises above 120. Select REBREATHE again, verify the PRESS2 drops to 0.
55. Disconnect the NICO® sensor.

6.7 Serial / Analog Testing

56. Verify switches 2 and 3 of S1 are “ON”, verify LED D2 is blinking on the 2763 board.
57. From the DIAGNOSTIC SCREENS select SYSTEM, verify the Analog Connected status is “NO”.
58. Connect pins 8 and 15 together on the rear panel ANALOG connector. Verify the Analog Connected status is “Yes”.
59. Connect pins 2 and 11 together on the rear panel ANALOG connector. Select ANALOG from the SYSTEM DIAGNOSTIC SCREEN. Press the knob in to cycle through the different Output values listed, verify the Input values below:

Output	Input
0	0 +5
128	64 ± 5
255	128 ± 5

60. Repeat for the following pin combinations; pins 3 and 12, pins 4 and 13, pins 5 and 14.
61. Connect pins 2 and 3 together on the RS232 “1” connector. Select SERIAL 1, verify TESTING-Ch1 appears followed by PASS-Ch1.
62. Connect pins 2 and 3 together and pins 7 and 8 together on the RS232 “2” connector. Select SERIAL 2, verify TESTING-Ch2 appears followed by PASS-Ch2.
63. Connect pins 2 and 3 together on the RS232 “3” connector. Select SERIAL 3, verify TESTING-Ch3 appears followed by PASS-Ch3.

64. Select EXIT to leave the DIAGNOSTIC SCREENS.
65. Set switches 2 and 3 on S1 on the 2763-01 board to the “OFF” position. Verify the red LED (D2) stops flashing.
66. Turn the monitor OFF. Reconnect the battery, ensure proper polarity hookup.

6.8 Safety Testing

67. Assemble the unit completely. Ensure there is no loose hardware inside.
68. Follow the leakage tester instructions for proper hookup and operation. Measure the monitor leakage current as follows. Verify a leakage current less than 25uA.
    - Monitor grounded
    - Monitor ungrounded
    - Monitor ungrounded with polarity reversed
69. Measure the monitor AC leakage from the shorted saturation test jack to the hot side of the AC line. Verify a leakage current less than 25uA.

7 Maintenance

7.1 General

This section presents information on general maintenance, such as battery and fuse replacement, disassembly and assembly instructions, and system software updates for the Model 7300.

7.2 Cleaning and Sterilization

To clean and/or sterilize the monitor and its accessories:

7.2.1 Single Patient Use NICO® Sensor

- Treat the NICO® Sensor in accordance with hospital protocol for single-patient use items.

7.2.2 CO_2/Flow Sensors

- Treat CO_2/Flow sensors in accordance with hospital protocol for single-patient use items.

7.2.3 CAPNOSTAT® CO_2 Sensor

- Do not immerse the sensor. Do not sterilize the sensor.
- The sensor can be cleaned and disinfected by wiping with solutions such as a 70% isopropyl alcohol, 2% gluteraldehyde, or 10% bleach solution. Then wipe down with a water dampened clean cloth to rinse. Dry before use.
- Make certain that the sensor windows are clean and dry before reuse.

7.2.4 NICO® Monitor

- Do not immerse the monitor. Do not sterilize the monitor.
- Turn the monitor off and unplug from the AC power source before cleaning.
- The monitor can be cleaned and disinfected by wiping with solutions such as a 70% isopropyl alcohol, 2% gluteraldehyde, or 10% bleach solution. Then wipe down with a water dampened clean cloth to rinse. Dry before use.

7.2.5 SpO_2 Finger Sensor

- Do not immerse the finger sensor. Do not sterilize the finger sensor.
- The sensor can be cleaned and disinfected by wiping with solutions such as a 70% isopropyl alcohol, 2% gluteraldehyde, or 10% bleach solution. Then wipe down with a water dampened clean cloth to rinse. Dry before use.
- Make certain that the finger sensor windows are clean and dry before reuse.
- After cleaning the finger sensor, perform a Quick Check to verify the sensor is functional (See “Sensor Quick Check” in User’s Manual).

7.2.6 SpO_2 Y-Sensor

- The Y-Sensor may be immersed up to—but not including—the connector, in a 2% gluteraldehyde solution, or 10% bleach solution. Refer to manufacturer's instructions and standard hospital protocols to determine recommended times for disinfection and sterilization.
- Rinse thoroughly with water and dry before use. (Do not rinse the connector).
- After cleaning or sterilizing the Y-Sensor, perform a Quick Check to verify the sensor is functional (See "Sensor Quick Check" in User's Manual).

7.2.7 SpO_2 Tapes and Foam Wraps

- Treat tapes and foam wraps in accordance with hospital protocol for single-patient use items.

7.2.8 Ear Clip

- Clean with a cloth dampened with 70% isopropyl alcohol. After cleaning, thoroughly wipe the ear clip with a clean, water dampened cloth.

7.3 Monitor Maintenance Schedules

The NICO® monitor performs a diagnostic self-test at powerup that checks the internal electronics. If this self test fails, the normal monitoring display will not appear. Remove the NICO® monitor from use and contact qualified service personnel.

The NICO® monitor should undergo inspection and safety checks on a regular basis or according to institutional protocol.

7.4 Battery Maintenance

The monitor may not power up on battery power if the battery is not sufficiently charged. If the NICO® monitor has not been used or powered by the AC Mains for an extended time—3 months or more—allow the battery to charge for 12 hours before use. (The internal battery may slowly discharge over long periods of non-use.)

To charge the battery, connect the line cord to an AC source and set the rear panel power switch ON (|). Check that the AC Mains Power Indicator on the front panel is illuminated (green). Allow the battery to charge for 12 hours. (Refer battery replacement to qualified service personnel.)

7.5 Disassembly

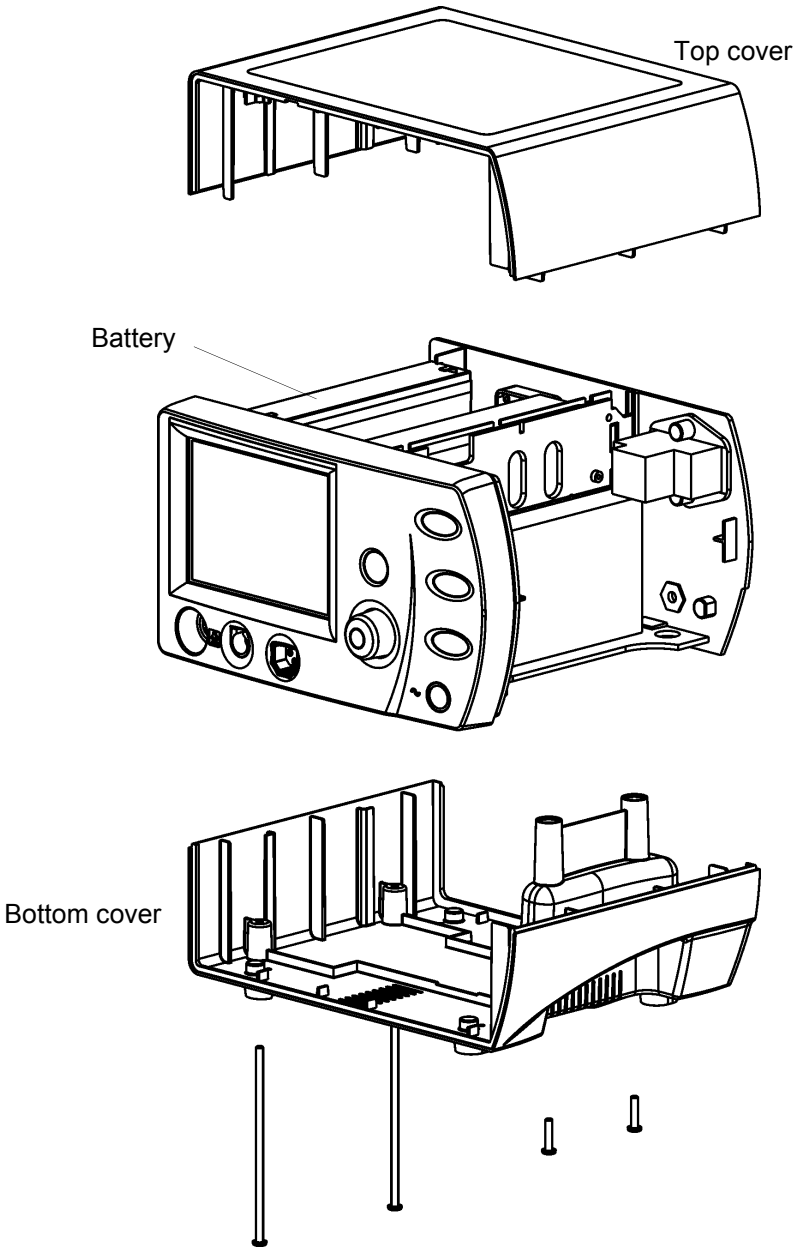
CAUTION: The Model 7300 contains static sensitive devices. Be sure to follow proper grounding procedures when handling the internal components to avoid damage from static discharge.

7.5.1 Equipment Required

- Phillips screwdriver
- Large flat-blade screwdriver
- Small flat-blade screwdriver

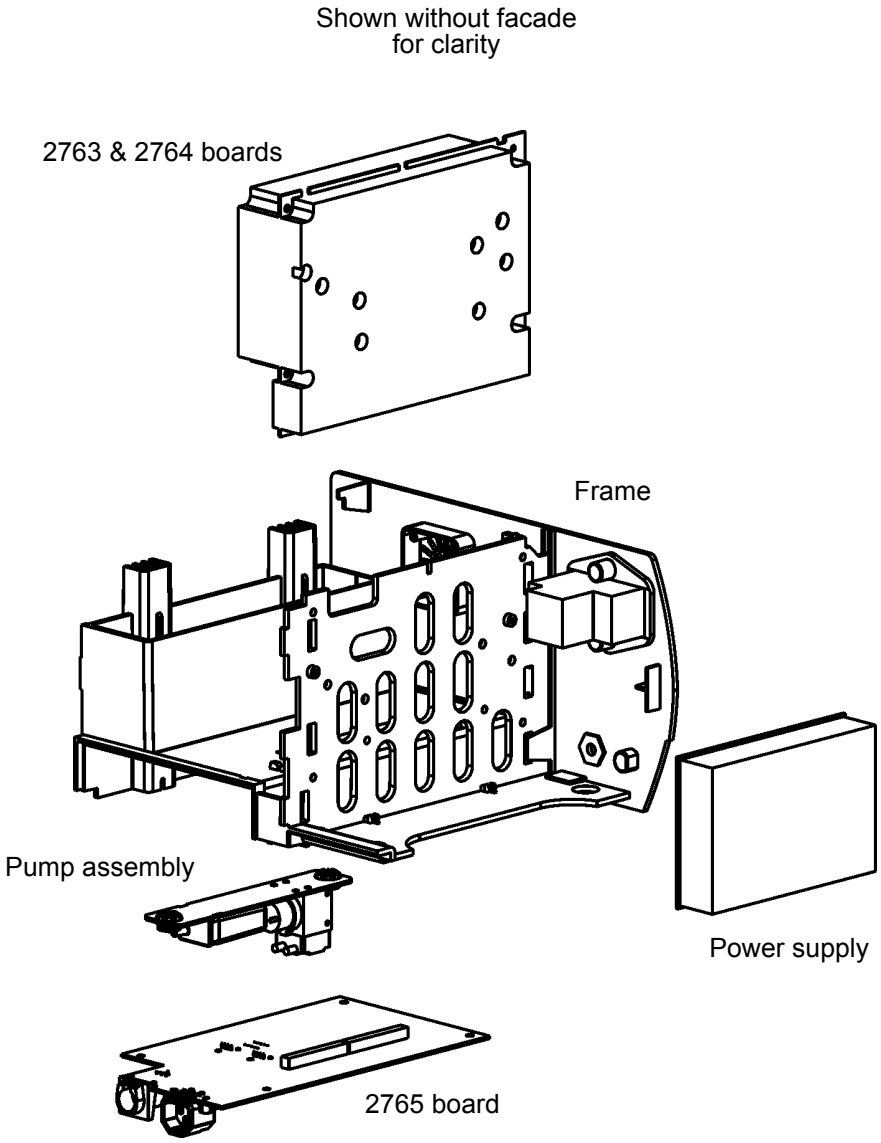
7.5.2 Disassembling Unit

1. Check that the monitor is OFF.
2. Set the rear panel power entry module switch to OFF (“O”). Remove the line cord from the power entry module (if connected).
3. Remove two screws from the body of the unit and two more from the handle. NOTE: Body screws are long.



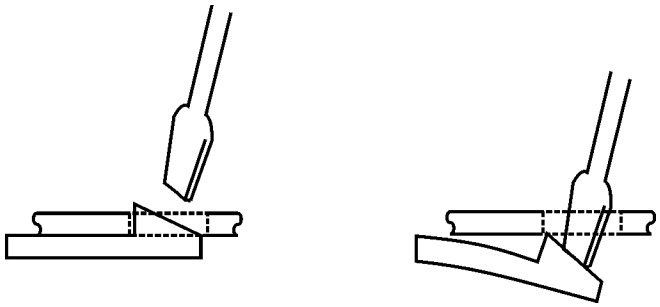
4. The top and bottom covers slide off. Place the covers and screws aside. Disconnect and remove the battery.

5. The power supply, 2763 and 2764 boards are accessible (on earlier units the rear panel may have to be removed to disassemble the 2763 and 2764 boards). To remove other assemblies further disassembly is required.

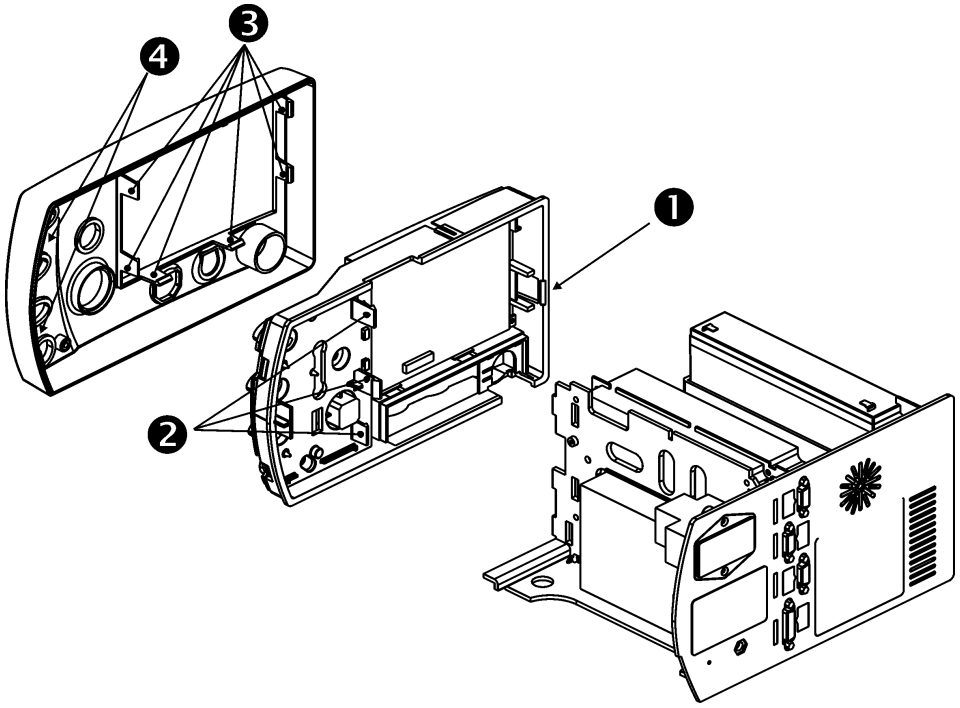


6. Disconnect the two ribbon cables from the facade assembly, J5 & J3 from the 2763 board and J1 & J3 from the 2765 board. Be sure to mark where they are connected for assembly later. Some units may have white RTV on these connections, this is to prevent the connection from loosening, cut the RTV and carefully pull the connector off, be careful not to pull the ribbon cable off from the connector. When assembling secure with GE RTV 162 (PN: 161102).
7. Disconnect the ground wires running from the CAPNOSTAT® connector and the 2764 board to the rear panel equipotential connector.

8. The facade assembly is held together by a series of tabs. To separate the parts use a flat blade screwdriver to push the tab through its' securing notch. This will release its' hold. It is best to release all the tabs on one side (or one area), then work to the other side while keeping the tabs from reseating themselves.



9. Using the large flat-blade screwdriver, gently pry the facade assembly from the frame first at location ❶, then at ❷ starting with the top tab, the middle, then the bottom.



10. To further disassemble the facade, use both the large and small flat-blade screwdrivers. Remove the knob from the facade. Use the large flat-blade screwdriver to gently pry the black section from the white facade while using the small flat-blade screwdriver to loosen the tabs at ❸ then ❹. The prying action of the large flat-blade screwdriver will keep the tabs from reseating themselves as they are loosened. Do not use excessive force, the plastic can be damaged or marred.

7.6 Reassembling Unit

CAUTION: The Model 7300 contains static sensitive devices. Be sure to follow proper grounding procedures when handling the internal components to avoid damage from static discharge.

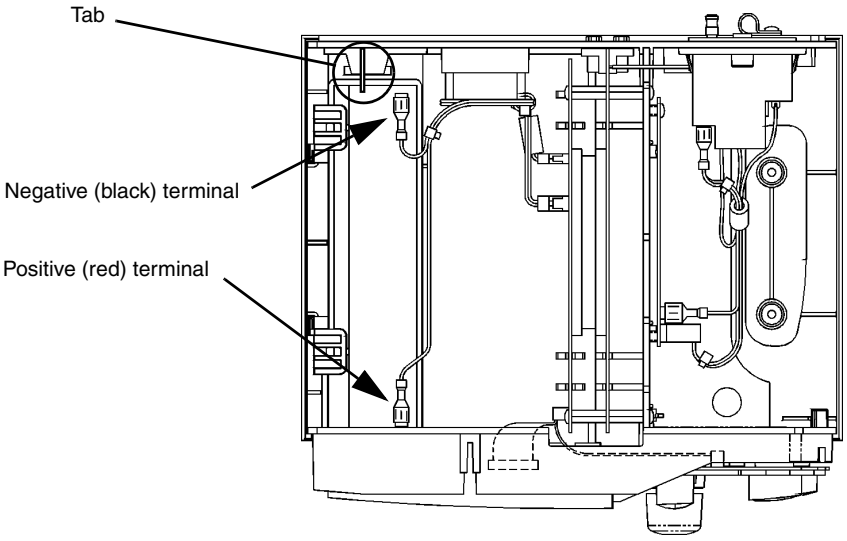
1. Refer to the 9226-01 Main Assembly print located in the last section of this manual for detailed assembly diagrams. Different parts of the drawing may apply depending upon the stage of disassembly of the monitor. Note locations of assemblies and routing of cables and any special notes that may apply.
2. Check that the line cord and battery are not connected. Verify no other external power sources are connected to any of the assemblies.
3. Check that there is no loose hardware or objects within the chassis assembly. Attach all board assemblies first then attach cables as necessary, verify all wires and cables are properly routed and secured.
4. When all the assemblies are secured and all cables and wire harnesses are in place connect the battery, be sure to connect wires correctly, red - positive, black - negative.
5. With the cover still off, connect the line cord and verify that the green AC Mains Power Indicator on the front panel illuminates. Press the power switch and verify the monitor powers up without any error messages (battery should be fully charged). Turn the monitor off, disconnect the line cord and reassemble the covers.

7.7 Replacing the Internal Battery

	Recyclable item. After the life cycle of the item has been met, disposal should be accomplished following national/local requirements.
	Separate collection. Appropriate steps must be taken to ensure that spent batteries are collected separately when disposed of. This symbol is found on the internal battery.
Pb	Indicates heavy metal content, specifically lead. This symbol is found on the internal battery and the monitor enclosure.

1. Unplug the line cord from the unit (if connected).

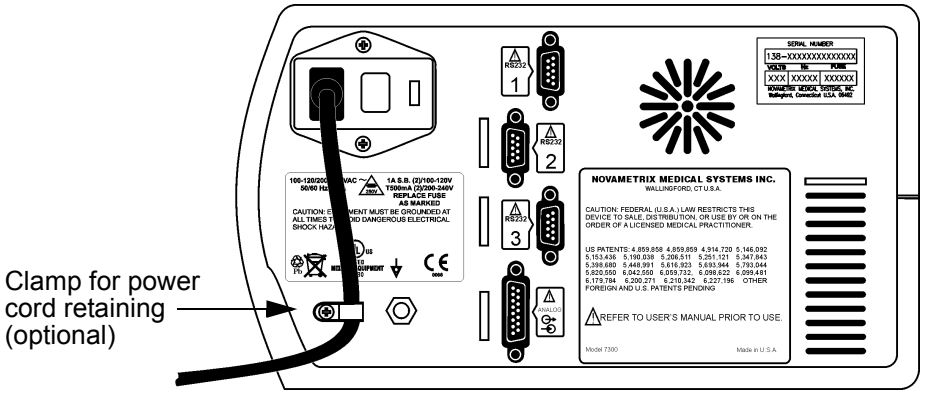
2. With the top cover removed, disconnect the positive then the negative lead from the battery terminals.



3. Newer units will have a tab that extends from the rear panel to the rear edge of the battery. To remove the battery on these units, carefully flex the tab to the left and tilt the battery to the right and pull the battery out. For other units simply slide the battery out by tilting the back up slightly to clear the front edge of the monitor and pulling straight up.
4. Replace the battery and reconnect the negative lead first, being careful to connect the negative (black) lead to the negative (black) terminal on the battery.
5. Connect the positive (red) lead to the positive (red) terminal. The unit may turn on when the positive lead is connected, simply press the power key to turn the unit off. To charge the battery, connect the line cord to the power cord entry module and to an AC source, set the rear panel power switch ON (|). Check that the AC Mains Power Indicator on the front panel is illuminated (green). Allow the battery to charge for 12 hours. (Refer battery replacement to qualified service personnel.)

7.8 Mains Voltage Configuration

The rear panel indicates the mains voltage setting for the monitor. Check that the voltage is correct before attaching the line cord and powering the monitor. The Model 7300 can operate from 100-120 VAC 50/60Hz or 200-240VAC 50/60Hz.


Clamp for power cord retaining (optional)
NOVAMETRIX MEDICAL SYSTEMS INC.
WALLINGFORD, CT U.S.A.
REFER TO USER'S MANUAL PRIOR TO USE.

Refer to the following section for fuse replacement.

7.8.1 Fuse Replacement

CAUTION: Replace fuses with same type and rating. Verify proper fuse value for mains voltage setting (see table below).

Mains Voltage	Fuses (Slo Blo)	Part No.
100-120 VAC	1.0 A 250V	515005
200-240 VAC	500mA 250V	515095

1. Check that the monitor is OFF.
2. Set the rear panel power entry module switch to OFF (“O”). Remove the line cord from the power entry module (if connected).
3. Using a flat blade screwdriver, pry the fuse access door open to expose the fuse housing and pry it out from the power entry module.
4. Replace the blown fuse(s) with the proper type and rating.
5. Re-install the fuse housing. When positioning the housing into the power entry module ensure that it is oriented correctly. Press the fuse housing back into the power entry module.
6. Close the fuse access door.

7.9 Software Update Instructions

The following procedure is for updating the monitor’s software from the supplied *NICO*® Software Update Kit using an IBM compatible computer.

7.9.1 Equipment Required

1. IBM compatible computer with Windows 9X operating system and an unused serial port (COM1 or COM2)
2. DB-9 male to DB-9 female serial communications cable (Null Modem Cable) Cat. No. 601012

Pin-out	
A	B
1	4
2	3
3	2
4	1
5	5
7	8
8	7
9	9

3. Update diskette PN: 9571-07-XX (XX = new firmware version)
4. Reply card

7.9.2 Setup

1. Connect the serial cable to the rear panel 9 pin connector marked “1” on the *NICO*® (see FIG. A).

2. Connect the other end of the cable to the computer's serial communications port[1] (see FIG. A). The update software allows use of either COM1 or COM2, the program will request which COM port to use before updating the software.

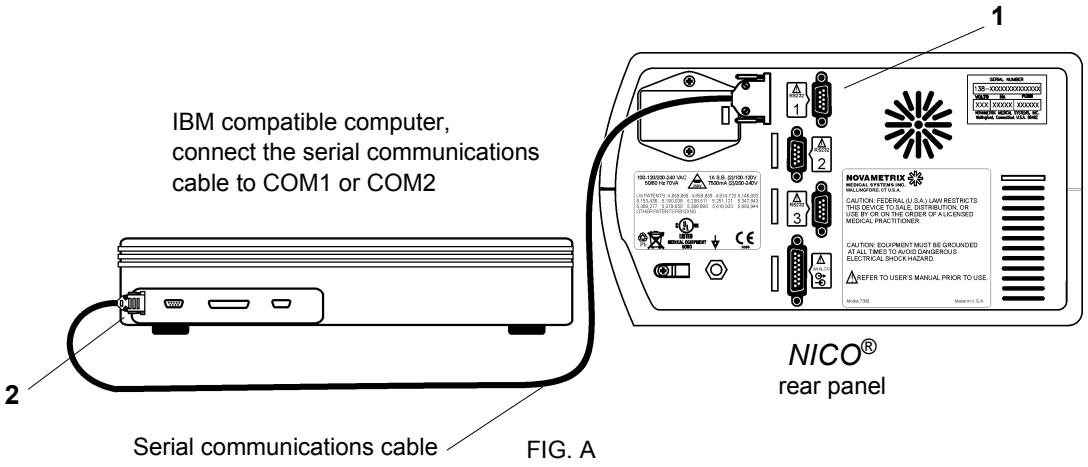
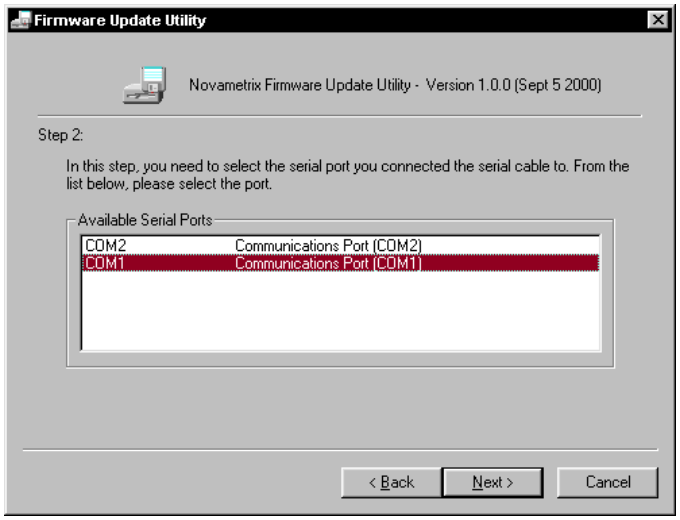


FIG. A

- Connect AC power to the monitor and turn the rear panel power switch ON (green LED on front panel lit). Turn the *NICO*® on.

7.9.3 Procedure

1. Insert the update diskette into the computer's floppy drive (typically drive A).
2. Run the executable on the diskette.
   - Double click the "My Computer" icon on the Desktop, then on the floppy icon "3½ Floppy (A:)" in the "My Computer" window.
   - Double click on the update icon in the "3½ Floppy (A:)" window.
3. Follow the Firmware Update Utility screen instructions.
   - Select the proper COM port in step 2. View the "Connection Status" for any instructions, "Ready to Download" should be displayed to continue. If the download does not start, try selecting the other COM port.


Firmware Update Utility
Novametrix Firmware Update Utility - Version 1.0.0 (Sept 5 2000)
Step 2:
In this step, you need to select the serial port you connected the serial cable to. From the list below, please select the port.
Available Serial Ports
COM2 Communications Port (COM2)
COM1 Communications Port (COM1)
< Back
Next >
Cancel

1. The location and availability of the serial communications ports (COM1, COM2) will vary from computer to computer. Refer to the computer's documentation for more information.

If you are not sure of the process, click “Cancel” button and call service or Novametrix Service Department at 1-800-243-3444, in Connecticut call collect (203) 265-7701.

- When the download starts, the *NICO*® screen will blank and “DOWNLOADING FIRMWARE TO INSTRUMENT DO NOT INTERRUPT!” will appear on the Firmware Update Utility screen. The Download Status will display the progress of the download.
- The procedure is complete when “DOWNLOAD COMPLETE” is displayed. Click on “Finish” to exit the Firmware Update Utility.

4. Check that the *NICO*® restarts and returns to normal operation; if not, perform the update procedure again or call Novametrix Service Department at 1-800-243-3444, in Connecticut call collect (203) 265-7701.
5. Remove the serial communications cable from the PC and the *NICO*®. Store the update diskette in a safe place. Record the serial number from the *NICO*® on the reply card. Fill in the remaining information and return the postage paid card to Novametrix.

8 Troubleshooting

This section is intended as a guide in determining possible causes for monitor malfunctions. The first section lists messages that may appear on the display followed by the reason. Not all of the messages indicate a fault, but may indicate an improper operating condition or be a signal for required user interaction. The second section lists symptoms with probable causes. If checking the causes offered does not remedy the problem, contact Novametrix Service Department.

8.1 Screen Messages

The following messages may appear in the “General Message Area”, refer to the User’s Manual for more information on the General Message Area.

General Message Area	Message Description
ALERTS OFF	Displayed as a reminder that the default for all user selectable alerts is OFF. To cancel the message, adjust any individual limit value and activate the audible alert. Both the alert limit and audible alert must be activated.
AMBIENT LIGHT COVER SpO_2 PROBE	The monitor detects interference on the SpO_2 sensor from ambient light. This can be corrected by covering the SpO_2 sensor, or possibly by changing the sensor site.
CHECK / CHANGE AIRWAY ADAPTER	A change in the CO_2 adapter portion of the NICO® Sensor is detected. Possible causes: • CAPNOSTAT® CO_2 sensor off adapter • High level of moisture and/or secretions in the adapter. The moisture can be drained from the NICO® Sensor and re-inserted in the circuit. Facing the pneumatic tubing upward as it exits the NICO® Sensor can minimize this.
CO_2 SENSOR FAILURE REPLACE SENSOR	A problem with the CAPNOSTAT® CO_2 sensor has been identified. Replace the CAPNOSTAT® CO_2 sensor and return it to Novametrix for exchange.
CO_2 SENSOR?	The CAPNOSTAT® CO_2 sensor is not connected to the NICO® monitor.
CO_2 ZERO REQUIRED (MENU → SETUP)	The CAPNOSTAT® CO_2 sensor needs to be zeroed. Press the **MENU** key, then select **SETUP**, then **CO2 ZERO NOW**, and follow the instructions on the screen. NOTE: the CO_2 adapter provided with the CAPNOSTAT® CO_2 sensor can be used for the CO_2 zero procedure rather than a new NICO® Sensor.
DEMO MODE	The monitor is in demonstration mode and is not displaying patient data (all data is simulated). To exit demo mode, turn the monitor off, then back on.
$ETCO_2$: XX mmHg	End tidal CO_2 is greater than 60 mmHg or exceeds the high alert limit. Appears in the general message area to supplement screens that do not display the $ETCO_2$ value.

General Message Area	Message Description
HIGH C.O.	The displayed cardiac output value is above the set alert limit in the **SET ALERTS** screen (press **MENU** key, then select **SET ALERTS** to view the alert limit settings).
HIGH $ETCO_2$	The displayed $ETCO_2$ value is above the set alert limit in the **SET ALERTS** screen (press **MENU** key, then select **SET ALERTS** to view the alert limit settings).
HIGH PULSE	The displayed pulse rate value is above the set alert limit in the **SET ALERTS** screen (press **MENU** key, then select **SET ALERTS** to view the alert limit settings).
HIGH RESP RATE	The displayed respiration rate value is above the set alert limit in the **SET ALERTS** screen (press **MENU** key, then select **SET ALERTS** to view the alert limit settings).
HIGH SpO_2	The displayed SpO_2 value is above the set alert limit in the **SET ALERTS** screen (press **MENU** key, then select **SET ALERTS** to view the alert limit settings).
INCOMPATIBLE CO_2 SENSOR	The wrong part number CAPNOSTAT® CO_2 sensor is connected to the NICO® monitor. Use only a CAPNOSTAT® CO_2 sensor with part number 9567-00 (this can be distinguished from other CAPNOSTAT® CO_2 sensor part numbers by the yellow part number label on the sensor's electrical connector).
INCOMPATIBLE FLOW SENSOR	The wrong flow sensor is connected to the NICO® monitor. Use only a NICO® Sensor, part numbers 8950-00, 8951-00, 8952-00, 9765-00, 9766-00 or 9767-00 (the correct flow sensor is an integral part of the NICO® Sensor).
INFANT MODE ON	**INFANT MODE** is enabled in the **SETUP** menu to accommodate neonatal and smaller patients (press **MENU** key, then select **SETUP** to adjust the **INFANT MODE** setting).
INSP CO_2: xx	(where xx is a numeric value with units of mmHg, kPa, or %). At least 3 mmHg, 0.1% or 0.1 kPa of CO_2 has been detected during inspiration (other than during rebreathing) for at least ten continuous seconds.
LOW C.O.	The displayed cardiac output value is below the set alert limit in the **SET ALERTS** screen (press **MENU** key, then select **SET ALERTS** to view the alert limit settings).
LOW $ETCO_2$	The displayed $ETCO_2$ value is below the set alert limit in the **SET ALERTS** screen (press **MENU** key, then select **SET ALERTS** to view the alert limit settings).
LOW PULSE	The displayed pulse rate value is below the set alert limit in the **SET ALERTS** screen (press **MENU** key, then select **SET ALERTS** to view the alert limit settings).
LOW RESP RATE	The displayed respiration rate value is below the set alert limit in the **SET ALERTS** screen (press **MENU** key, then select **SET ALERTS** to view the alert limit settings).
LOW SpO_2	The displayed SpO_2 value is below the set alert limit in the **SET ALERTS** screen (press **MENU** key, then select **SET ALERTS** to view the alert limit settings).
MONITOR INOPERABLE AIRWAY ZERO ERROR	The NICO® monitor detected a problem with its pneumatic flow and pressure sub-system. Contact qualified personnel for monitor repair or exchange.
MONITOR INOPERABLE BARO PRESS ERROR	The NICO® monitor detected a problem with its internal barometric pressure sensor. Contact qualified personnel for monitor repair or exchange.

General Message Area	Message Description
MONITOR INOPERABLE CLOCK FAILURE	The NICO® monitor detected a problem with its internal clock. Contact qualified personnel for monitor repair or exchange.
MONITOR INOPERABLE SELF-TEST ERROR	The NICO monitor detected a problem with its internal memory. Contact qualified personnel for monitor repair or exchange.
MONITOR INOPERABLE FLOW ZERO ERROR	The NICO® monitor detected a problem with its flow zeroing sub-system or related pneumatic components. Contact qualified personnel for monitor repair or exchange.
MONITOR INOPERABLE MARS HDW ERROR	The NICO monitor detected a problem with its pulse oximetry sub-system. Contact qualified personnel for monitor repair or exchange.
MONITOR INOPERABLE NICO VALVE ZERO ERR	The NICO® monitor detected a problem with its internal rebreathing valve control circuitry or related pneumatic components. Contact qualified personnel for monitor repair or exchange.
MONITOR INOPERABLE SpO_2 HDW ERROR	The NICO® monitor detected a problem with its pulse oximetry sub-system. Contact qualified personnel for monitor repair or exchange.
MVi-MVe MISMATCH	The NICO monitor detected greater than 15% difference between MVi and MVe measurements. NICO cycle must be active. Check for leaks in the circuit.
NO RESP: xx:xx	The time selected in the **SET ALERTS** screen for the NO RESP (no respiration) alert was exceeded since the end of the last detected breath (press **MENU** key, then select **SET ALERTS** to view the alert limit settings).
PULSE SEARCH	The pulse oximeter is not detecting a sufficient pulse. This could be due to: • SpO_2 sensor is off of the patient • Insufficient perfusion at the site • Tissue at the site is too thick or too thin
SpO_2?	The monitor is in N-395 interface mode, but SpO_2 data is not being received via the interface. An alarm is not generated.
SpO_2 PROBE FAILURE	The pulse oximeter sensor is faulty. Replace the sensor and contact qualified service personnel.
SpO_2 PROBE?	• The pulse oximeter sensor was not connected to the NICO® monitor when it was powered up. • (Flashing) SpO_2 sensor was disconnected from the monitor after it was powered up. Acknowledge by pressing the Silence key.
WARMUP	The CAPNOSTAT® CO_2 sensor is not at proper operating temperature yet.

The following messages may appear in the “C.O. Message Area”, refer to the User’s Manual for more information on the C.O. Message Area.

C.O. Message Area	Message Description
BLOOD GASES HAVE BEEN RESET	A NICO® cycle has started after 20 minutes of a no respiration time-out. Data not available when no breaths are detected 20 minutes after the last detected breath.
NOISY SIGNALS	The NICO® monitor was not able to calculate a cardiac output value. This can be due to: • Spontaneous breaths or efforts • Surgeon moving the lungs • Ventilator adjustments

C.O. Message Area	Message Description
CONSIDER USING SMALL NICO SENSOR	Resizing the NICO® Loop was not effective because the ventilator set tidal volume is less than 300 ml. The NICO® monitor is suggesting a different sized sensor, with smaller loop, to correct the condition.
CONSIDER USING STANDARD NICO SENSOR	If a small NICO® Sensor is currently in use: Resizing the NICO® Loop was not effective because the ventilator set tidal volume is greater than 500 ml. The NICO® monitor is suggesting a different sized sensor, with a larger loop, to correct the condition. If a large NICO® Sensor is currently in use: Resizing the NICO® Loop was not effective because the ventilator set tidal volume is less than 1000 ml. The NICO® monitor is suggesting a different sized sensor, with a smaller loop, to correct the condition.
CONSIDER USING LARGE NICO SENSOR	Resizing the NICO® Loop was not effective because the ventilator set tidal volume is greater than 1000 ml. The NICO® monitor is suggesting a different sized sensor, with a larger loop, to correct the condition.
EXPAND LOOP	The NICO® Loop (expandable rebreathing volume on the NICO® Sensor) needs to be expanded. Expand the loop by approximately 3-6 inches or until the message is removed. Note that the message is displayed only during the rebreathing phase of the NICO® cycle. If the loop is not appropriately sized by the end of the rebreathing phase, the message will be removed and displayed again during the next rebreathing phase. If this message persists with maximal expansion of the NICO® Loop, the tidal volume may be too large for the ventilatory conditions for the NICO® monitor to report accurate results.
NEXT ↻: xx:xx	There are x:xx minutes:seconds until the beginning of the next rebreathing period (provided as an indicator as to the current state of the NICO® cycle).
NICO SENSOR?	The NICO® Sensor has not been connected to the monitor since it was last turned on.
↻REBREATHING	The patient is currently rebreathing a portion of his/her tidal volume in order for the NICO® monitor to calculate cardiac output (provided as an indicator of the current state of the NICO® cycle). The rebreathing phase of the NICO® cycle lasts for 50 seconds.
REBREATHING OFF	Rebreathing and therefore C.O. measurements are currently disabled. The **STOP/CONTINUE REBREATHING** key is illuminated amber while rebreathing is off, and can be pressed to enable rebreathing and C.O. measurements. Rebreathing is off when: • The monitor is first turned on until the **STOP/CONTINUE REBREATHING** key is pressed • The **STOP/CONTINUE REBREATHING** key is pressed while C.O. measurements are enabled • The monitor detected a system fault or condition which warrants automatic disabling of C.O. measurements
REBREATHING OFF ADAPTER DISCONNECT REMOVE FROM CIRCUIT	The NICO® Sensor was disconnected from the monitor after C.O. measurements had been made since the last power-up. The NICO® Sensor should be removed from the breathing circuit in order to avoid leaking breathing circuit gas through the sensor connector.
REBREATHING OFF LARGE NICO SENSOR IDENTIFIED	A large size NICO® Sensor was just connected to the NICO® monitor.
REBREATHING OFF SMALL NICO SENSOR IDENTIFIED	A small size NICO® Sensor was just connected to the NICO® monitor.

C.O. Message Area	Message Description
REBREATHING OFF STANDARD NICO SENSOR IDENTIFIED	A standard size NICO® Sensor was just connected to the NICO® monitor.
REBREATHING OFF NICO SENSOR FAILURE	A problem with the NICO® Sensor was detected by the monitor. Discard the sensor and replace it. If the problem persists, contact qualified service personnel.
REBREATHING OFF PRESS ∅ KEY TO CONTINUE	Rebreathing and therefore C.O. measurements are currently disabled and can be enabled by pressing the **STOP / CONTINUE REBREATHING** key.
REBREATHING PAUSED WAITING FOR $ETCO_2$ < XX	Rebreathing and therefore C.O. measurements have been temporarily paused automatically by the monitor, and will resume automatically once the indicated parameter is within the stated range (here, XX = 85 mmHg, 11.5 kPa, 11.5 %).
REBREATHING PAUSED WAITING FOR $ETCO_2$ > XX	Rebreathing and therefore C.O. measurements have been temporarily paused automatically by the monitor, and will resume automatically once the indicated parameter is within the stated range (here, XX = 15 mmHg, 2.0 kPa, 2.0 %).
REBREATHING PAUSED WAITING FOR RR < 60 br/m	Rebreathing and therefore C.O. measurements have been temporarily paused automatically by the monitor, and will resume automatically once the indicated parameter is within the stated range.
REBREATHING PAUSED WAITING FOR RR > 3 br/m	Rebreathing and therefore C.O. measurements have been temporarily paused automatically by the monitor, and will resume automatically once the indicated parameter is within the stated range.
REBREATHING PAUSED WAITING FOR VCO_2 > 20 mL/min	Rebreathing and therefore C.O. measurements have been temporarily paused automatically by the monitor, and will resume automatically once the indicated parameter is within the stated range.
REBREATHING PAUSED WAITING FOR Vt > 200 mL	Rebreathing and therefore C.O. measurements have been temporarily paused automatically by the monitor, and will resume automatically once the indicated parameter is within the stated range.
RETRACT LOOP	The NICO® Loop (expandable rebreathing volume on the NICO® Sensor) needs to be retracted (made smaller). Retract the loop by approximately 3-6 inches or until the message is removed. Note that the message is displayed only during the rebreathing phase of the NICO® cycle. If the loop is not appropriately sized by the end of the rebreathing phase, the message will be removed and displayed again during the next rebreathing phase. If this message persists with the NICO® Loop at its minimal size, the tidal volume may be too small for the ventilatory conditions for the NICO® monitor to report accurate results.

The following messages may appear in the “General Message Area” in respiratory mechanics mode, refer to the User’s Manual for more information on the General Message Area.

General Message Area	Message Description
ADAPTER DISCONNECT REMOVE FROM CIRCUIT	The CO_2/Flow sensor is not connected to the NICO® monitor. The CO_2/Flow sensor should be removed from the breathing circuit in order to avoid leaking breathing circuit gas through the sensor’s connector. NOTE: If a two-line message will not fit in the General Message Area because other higher priority messages are present, the message “FLOW SENSOR?” will be used for the same condition.

General Message Area	Message Description
ADULT CO_2/FLOW SENSOR IDENTIFIED	An adult size CO_2/Flow sensor was just connected to the NICO® monitor.
ALERTS OFF	Displayed as a reminder that the default for all user selectable alerts is OFF. To cancel the message, adjust any individual limit value and activate the audible alert. Both the alert limit and audible alert must be activated.
AMBIENT LIGHT COVER SpO_2 PROBE	The monitor detects interference on the SpO_2 sensor from ambient light. This can be corrected by covering the SpO_2 sensor, or possibly by changing the sensor site.
CHECK / CHANGE AIRWAY ADAPTER	A change in the CO_2 adapter portion of the CO_2/Flow sensor is detected. Possible causes: • CAPNOSTAT® CO_2 sensor off adapter • High level of moisture and/or secretions in the adapter. Replace if needed.
CO_2 SENSOR FAILURE REPLACE SENSOR	A problem with the CAPNOSTAT® CO_2 sensor has been identified. Replace the CAPNOSTAT® CO_2 sensor and return it to Novametrix for exchange or repair.
CO_2 SENSOR?	The CAPNOSTAT® CO_2 sensor is not connected to the NICO® monitor.
CO_2 ZERO REQUIRED (MENU ➔ SETUP)	The CAPNOSTAT® CO_2 sensor needs to be zeroed. Press the **MENU** key, then select **SETUP**, then **CO2 ZERO NOW**, and follow the instructions on the screen. NOTE: the CO_2 adapter provided with the CAPNOSTAT® CO_2 sensor can be used for the CO_2 zero procedure rather than a new sensor.
DEMO MODE	The monitor is in demonstration mode and is not displaying patient data (all data is simulated). To exit demo mode, turn the monitor off, then back on.
$ETCO_2$ > XX mmHg	End tidal CO_2 is greater than 60 mmHg or exceeds the high alert limit. Appears in the general message area to supplement screens that do not display the $ETCO_2$ value.
FLOW SENSOR?	The CO_2/Flow sensor is disconnected. NOTE: This message may also be used in place of ADAPTER DISCONNECT REMOVE FROM CIRCUIT, when a two-line message will not fit in the General Message Area.
HIGH $ETCO_2$	The displayed $ETCO_2$ value is above the set alert limit in the **SET ALERTS** screen (press **MENU** key, then select **SET ALERTS** to view the alert limit settings).
HIGH PIP	The displayed PIP value is above the set alert limit in the **SET ALERTS** screen (press **MENU** key, then select **SET ALERTS** to view the alert limit settings).
HIGH PULSE	The displayed pulse rate value is above the set alert limit in the **SET ALERTS** screen (press **MENU** key, then select **SET ALERTS** to view the alert limit settings).
HIGH RESP RATE	The displayed respiration rate value is above the set alert limit in the **SET ALERTS** screen (press **MENU** key, then select **SET ALERTS** to view the alert limit settings).
HIGH SpO_2	The displayed SpO_2 value is above the set alert limit in the **SET ALERTS** screen (press **MENU** key, then select **SET ALERTS** to view the alert limit settings).
INCOMPATIBLE CO_2 SENSOR	The wrong part number CAPNOSTAT® CO_2 sensor is connected to the NICO® monitor. Use only a CAPNOSTAT® CO_2 sensor with part number 9567-00 (this can be distinguished from other CAPNOSTAT® CO_2 sensor part numbers by the yellow part number label on the sensor's electrical connector).

General Message Area	Message Description
INCOMPATIBLE FLOW SENSOR	The wrong flow sensor is connected to the NICO® monitor. Use only a NICO® CO_2/Flow sensor part number 9765-00, 9766-00, or 9767-00. If message persists, a hardware error is may exist. Contact qualified personnel for monitor repair or exchange.
INSP CO_2: xx	(where xx is a numeric value with units of mmHg, kPa, or %). At least 3 mmHg, 0.1% or 0.1 kPa of CO_2 has been detected during inspiration (other than during rebreathing) for at least ten continuous seconds.
LOW $ETCO_2$	The displayed $ETCO_2$ value is below the set alert limit in the **SET ALERTS** screen (press **MENU** key, then select **SET ALERTS** to view the alert limit settings).
LOW PULSE	The displayed pulse rate value is below the set alert limit in the **SET ALERTS** screen (press **MENU** key, then select **SET ALERTS** to view the alert limit settings).
LOW RESP RATE	The displayed respiration rate value is below the set alert limit in the **SET ALERTS** screen (press **MENU** key, then select **SET ALERTS** to view the alert limit settings).
LOW SpO_2	The displayed SpO_2 value is below the set alert limit in the **SET ALERTS** screen (press **MENU** key, then select **SET ALERTS** to view the alert limit settings).
MONITOR INOPERABLE AIRWAY ZERO ERROR	The NICO® monitor detected a problem with its pneumatic flow and pressure sub-system. Contact qualified personnel for monitor repair or exchange.
MONITOR INOPERABLE BARO PRESS ERROR	The NICO® monitor detected a problem with its internal barometric pressure sensor. Contact qualified personnel for monitor repair or exchange.
MONITOR INOPERABLE CLOCK FAILURE	The NICO® monitor detected a problem with its internal clock. Contact qualified personnel for monitor repair or exchange.
MONITOR INOPERABLE FLOW ZERO ERROR	The NICO® monitor detected a problem with its flow zeroing sub-system or related pneumatic components. Contact qualified personnel for monitor repair or exchange.
MONITOR INOPERABLE SpO_2 HDW ERROR	The NICO® monitor detected a problem with its pulse oximetry sub-system. Contact qualified personnel for monitor repair or exchange.
NEONATAL CO_2/FLOW SENSOR IDENTIFIED	A neonatal size CO_2/Flow sensor was just connected to the NICO® monitor.
NO RESP: xx:xx	The time selected in the **SET ALERTS** screen for the NO RESP (no respiration) alert was exceeded since the end of the last detected breath (press **MENU** key, then select **SET ALERTS** to view the alert limit settings).
PEDIATRIC CO_2/FLOW SENSOR IDENTIFIED	A pediatric size CO_2/Flow sensor was just connected to the NICO® monitor.
PULSE SEARCH	The pulse oximeter is not detecting a sufficient pulse. This could be due to: • SpO_2 sensor is off of the patient • Insufficient perfusion at the site • Tissue at the site is too thick or too thin
SpO_2?	The monitor is in N-395 interface mode, but SpO_2 data is not being received via the interface. An alarm is not generated.
SpO_2 PROBE FAILURE	The pulse oximeter sensor is faulty. Replace the sensor and contact qualified service personnel.
SpO_2 PROBE?	• The pulse oximeter sensor was not connected to the NICO® monitor when it was powered up. • (Flashing) SpO_2 sensor was disconnected from the monitor after it was powered up. Acknowledge by pressing the Silence key.

General Message Area	Message Description
WARMUP	The CAPNOSTAT® CO_2 sensor is not at proper operating temperature yet.

8.2 Additional troubleshooting

The following table lists symptoms and possible causes that may be corrected by servicing the electronic components inside the monitor.

Symptom	Explanation
Flow zero error	Check for moisture in pneumatic tubing on the 2765-01 circuit board. Differential transducer malfunction (IC18 or 2769-01 board) on 2765-01 circuit board. Leaking tubing or solenoids.
MONITOR INOPERABLE message	Check ribbon cable between 2764-01 and 2765-01 boards.
Monitor will not turn on	Check AC input, battery and main fuses. Check crystal Y1 on 2763-01 board.
Blank display on power up	Check ribbon cable connections on front panel board.
Check Airway Adapter	Verify proper zeroing procedure, refer to User's Manual.
CO_2 warmup message always displayed	Case heaters in CAPNOSTAT® CO_2 sensor malfunction. Check fuse F3 and F6 on 2764-01 board.
NICO sensor intermittent "not connected" message	Check flow input housing on sensor, verify no cracks or damage.
Software update cannot be completed	Reboot computer used for updating. Restart software upgrade procedure. Verify proper operation of COM port and that the correct cable is being used.
Monitor on and front panel DATA ENTRY LED blinks with no display (other LEDs on but do not blink)	1 blink - RAM test failure. Contact qualified personnel for monitor repair or exchange. 2 blinks - bootcode ROM checksum test failure. Contact qualified personnel for monitor repair or exchange. 3 blinks - maincode ROM checksum test failure (software update may correct problem). Contact qualified personnel for monitor repair or exchange.

9 Specifications

9.1 General

Specifications for the Respironics Novametrix, Inc. NICO® Monitor, Model 7300, are listed for informational purposes only, and are subject to change without notice.

9.2 Cardiac Output

- Measurement Frequency: Rebreathing cardiac output measurement made every three minutes, rebreathing period is 35 seconds.
- Cardiac Output Range: 0.5-19.9 liters/minute
- Cardiac Output Resolution: 0.1 liters/minute
- Pulmonary Capillary Blood Flow (PCBF) Range: 0.5-19.9 L/min, Resolution: 0.1 L/min
- Cardiac Index Range: 0-9.9 L/min/meter^2, Resolution: 0.1 L/min/meter^2
- Stroke Volume Range: 0-250 ml, Resolution: 1 ml
- Rebreathing Valve/sensor:
  - Valve type: dual diaphragm, pneumatically controlled
  - Return spring: automatically returns valve to normal position
  - Resistance: 3 cmH_2O/L/min maximum
  - Rebreathed volume: normal position 35 ml; rebreathing position 150-450 ml (std.)
  - CO_2/flow sensor: integrated into valve assembly
- Parameter limits for NICO® measurements:
  - VCO_2: >20 ml/min
  - RR: >3, <60
  - Vt: >200 (small and standard), >400 (large)
  - $ETCO_2$:>15, <85 mmHg (<100 mmHg during rebreathing)
    >2.0, <11.5 kPa or % (<13.5 kPa or % during rebreathing)

9.3 CO_2

- Principle of Operation: Non-Dispersive Infrared (NDIR) absorption, dual wavelength ratiometric-single beam optics, mainstream sensor.
- Response Time: Less than 60 ms
- Gas composition effects: O_2, N_2O (operator selectable)
- CAPNOSTAT® CO_2 Sensor:
  - Weight: Less than 18 g without cable
  - Sensor Size: 1.3 x 1.67 x .85 inches (3.3 x 4.2 x 2.2 cm), 8 foot cable (2.44 m)

- Construction: Durable high performance plastic, ultra-flexible cable. Shock Resistant: Sensor will withstand a 6 foot drop to a tile floor.
- End Tidal CO_2:
  - Range: 0-150 mmHg, 0-20 kPa or % at Pb 760 mmHg
  - Accuracy: ± 2 mmHg for 0-40 mmHg, ± 5% of reading for 41-70 mmHg, ± 8% of reading for 71-150 mmHg
- Respiratory Rate:
  - Range: 2-150 breaths/min
  - Accuracy: ± 1 breath/min

9.4 Flow

- Flow Range (L/min) at Pb 760 mmHg, room air, 35°C
  - Adult: 2 to 180
  - Pediatric: .5 to 100
  - Neonatal: .25 to 25
- Flow Accuracy: Greater of ± 3% reading or:
  - Adult: .5 L/min
  - Pediatric: .25 L/min
  - Neonatal: .125 L/min
- Tidal Volume Range (ml)
  - Adult: 200 to 3000
  - Pediatric: 30-400
  - Neonatal: 1-100
- Airway Pressure Range (cmH_2O): ± 120
  - Accuracy: greater of 0.5 cmH_2O or ± 2% reading
- Gas composition effects: O_2, anaesthetic agent, CO_2, N_2O, N_2, He (operator selectable)

9.5 SpO_2

- Oxygen Saturation
  - Range: 0-100%
  - Accuracy: ± 2% for 80-100% (for 1 standard deviation or approximately 68% of readings), unspecified for 0-79%
  - Averaging Time: 2 seconds
- Pulse Rate:
  - Range: 30-250 beats per minute
  - Accuracy: ± 1% of full scale (for 1 standard deviation or approximately 68% of readings)
  - Averaging Time: 8 seconds

9.6 Monitor Specifications

- Classification (IEC601-1): Class I/internal power source, type BF, continuous operating mode, enclosure protection rating IPX0.

- Operating Environment: 50-104° F (10-40° C), 10-90% relative humidity (non-condensing)
- Size: Height 6.5 in., Width 10.75 in., Depth 9.5 in.
- Weight: 9 lbs, 6 oz.
- Power: 100-240 VAC, 50-60 Hz, 70VA
- Fuse Rating: 100-120 VAC, 1.0 A 250 V Slo-Blo (x2); 200-240 VAC, T 500 mA/ 250 V (x2)
- Battery: Internal, Sealed lead-acid gel-cell, 45 minute life on full charge (on-screen life indicator), 12 hours recharge time.
- Display: 4.625 x 3.5 inch EL, 320 x 240 pixels
- Electromagnetic Emissions: Conforms to EMC Directive 89/336/EEC, CISPR Class A. Tested to EN55011 (1991) and CISPR11 (1990).
- Electromagnetic Immunity: Conforms to EMC Directive 89/336/EEC, EN50082-1 (1992). Tested to IEC801-3 (1984) Radiated Immunity. Tested to IEC601-1 (1988) and A1:(1991) A2:(1995). Tested to IEC801-2 (1991) ESD, IEC801-4 (1988) EFT, and IEC801-5 (1991) Surge Immunity.

9.7 RS232 Communications

- RS232 Communications Ports:

Pin #	RS232-1	RS232-2	RS232-3
2	Rx	Rx	Rx
3	Tx	Tx	Tx
5	Ground	Ground	Ground
7	n/a	RTSB	n/a
8	n/a	CTSB	n/a
9	n/a	Power	n/a

9.8 Analog Specifications

- Analog Input/Output Port (selectable, 0 to 1 volt range):
  - C.O. - Cardiac Output, 0-20 L/m, 50mV/L/m
  - CI - Cardiac Index, 0-20 L/m, 50mV/L/m
  - SV - Stroke Volume, 0-20 L/m, 50mV/L/m
  - PCBF - 0-20 L/m, 50 mV/L/m
  - $ETCO_2$ - 0-150 mmHg, 0-20 kPa or %, 6.67mV/mmHg
  - SpO_2 - 0-100%, 10mV/%
  - Resp Rate - 0-150 br/min, 6.67mV/br/min
  - Pulse Rate - 0-250 bpm, 4mV/bpm
  - CO_2 Waveform - 0-150 mmHg, 0-20 kPa or %, 6.67mV/mmHg
  - Pleth Waveform - auto scaled
  - Flow Waveform - -125 to +125 L/m, 4mV/L/m
  - Airway Pressure Waveform - -20 to +105 cmH_2O, 8mV/cmH_2O

Pin#	Description	Pin #	Description
1	Ground	9	Ground
2	Channel 1 - input (not enabled)	10	Ground
3	Channel 2 - input (not enabled)	11	Channel 1 - output
4	Channel 3 - input (not enabled)	12	Channel 2 - output
5	Channel 4 - input (not enabled)	13	Channel 3 - output
6	Ground	14	Channel 4 - output
7	Ground	15	Input/Output Sense
8	Ground		

10 *NICO*® Accessories

Catalog No.	Description
9226-00	***NICO*® Cardiopulmonary Management System**, Model 7300 Includes: Monitor, *CAPNOSTAT*® CO_2 Sensor, SpO_2 Sensor, Power Cord and User's Manual. Warranty for *NICO*® Monitor and *CAPNOSTAT*® CO_2 Sensor is 2 years.
8950-00	***NICO*® Sensor** (10 per box) **Small size (for tidal volumes of 200 - 500 mL)**
8951-00	***NICO*® Sensor** (10 per box) **Standard size (for tidal volumes of 400 - 1000 mL)**
8952-00	***NICO*® Sensor** (10 per box) **Large size (for tidal volumes of 750 - 1500 mL)**
9567-00	***CAPNOSTAT*® CO_2 Sensor - NICO**
6934-00	**Cable Management Straps** for use with the *CAPNOSTAT*® CO_2 Sensor. Organizes and holds multiple cables and tubings (package of 5)
8751-00	***CAPNOSTAT*® CO_2 Sensor Cable Holding Clips** (50 per box)
8776-00	***SuperBright*™ Finger Sensor** (10 ft. sensor cable) 1 yr. warranty
8791-00	***SuperBright*™ Y-Sensor** (10 ft. sensor cable) 90 day warranty
9765-00	***NICO*® CO_2/Flow Sensors** (10 per box) **Neonatal size**
9766-00	***NICO*® CO_2/Flow Sensors** (10 per box) **Pediatric size**
9767-00	***NICO*® CO_2/Flow Sensors** (10 per box) **Adult size**
6063-01	**Single Patient Use Airway Adapter** - (1 piece) Adult size
6455-00	**Single Patient Use SpO_2 Sensor (10 per box) Pediatric/Adult**
6455-25	**Single Patient Use SpO_2 Sensor (25 per box) Pediatric/Adult**
6480-00	**Single Patient Use SpO_2 Sensor (10 per box) Neonatal/Pediatric**
6480-25	**Single Patient Use SpO_2 Sensor (25 per box) Neonatal/Pediatric**
4941-00	**Saturation Sensor Extension Cable** (4 feet)
4942-00	**Saturation Sensor Extension Cable** (6 feet)
4943-00	**Saturation Sensor Extension Cable** (10 feet)
5266-00	**Saturation Sensor Extension Cable** (25 feet)
6147-00	**Saturation Sensor Extension Cable** (50 feet)
8828-00	**20mm Wrap Style Y-Strip Taping System** (100 per box) Neonatal foot and hand, pediatric toe or finger, color coded blue
8829-00	**25mm Wrap Style Y-Strip Taping System** (100 per box) Neonatal foot and hand, color coded green
8831-00	**20mm Finger Style Taping System** (100 per box) Use on pediatric finger or on small adult finger, color coded blue
8832-00	**25mm Finger Style Taping System** (100 per box) Use on adult finger, color coded green
6929-00	**Adhesive Foam Wraps**, Large (25 per box)
6968-00	**Adhesive Foam Wraps**, Small (25 per box)
8836-00	**Non-Adhesive Foam Wraps**, Large (25 per box)
8943-00	**Non-Adhesive Foam Wraps**, Small (25 per box)
6131-50	**Ear Clips** (5 per box)
6131-25	**Ear Clips** (25 per box)

Catalog No.	Description
8700-00	**Adhesive Dots** (200 per box)
9861-00	**Flow Connector Cap**, 3 port (25 per bag)
601012	***NICO® Monitor*** 9-pin to 9-pin null modem (crossover) cable
600026	**Power Cord** (included with monitor)
9226-23	***NICO® Monitor*** User Manual
9226-90	***NICO® Monitor*** Service Manual
9960PED-00	***CAPNO$_2$mask***™ - Pediatric O_2 Delivery/CO_2 Mainstream Monitoring Mask (10 per bag)
9960STD-00	***CAPNO$_2$mask***™ - Adult Standard O_2 Delivery/CO_2 Mainstream Monitoring Mask (10 per bag)
9960LGE-00	***CAPNO$_2$mask***™ - Adult Large O_2 Delivery/CO_2 Mainstream Monitoring Mask (10 per bag)

11 Parts Lists

11.1 9226-00 Non-Invasive Cardiac Output Monitor, Model 7300

Item Nbr	Description	Quantity
315032	LABEL, 120VAC	1
600026	LINE CORD, AC	1
9026-32	LABEL, “MANUFACTURED IN”	1
4470-32	LABEL, CAUTION GROUND	1
1217-32	REPAIR LABEL	1
1003-32	LABEL, SERIAL NUMBER	1
9226-01	MAIN ASSY, 7300 - NICO	1
9501-13	FACADE W PAD PRINT	1
9486-32	REAR PNL LABEL SET	1
9487-32	TOP COVER LABEL	1

11.2 9488-01 Bottom Cover Assembly, Model 7300

Item Nbr	Description	Quantity
161007	ADHESIVE 414	0
284261	SCREW, 4-40 X 5/8	0
5826-10	FOOT PAD	4
5760-16	WHT L FOOT, KICKSTAND	1
5761-16	WHT R FOOT, KICKSTAND	1
9336-10	KICKSTAND	1
9488-16	BOTTOM COVER	1

11.3 9226-01 Main Assy

Item Nbr	Description	Quantity
284261	SCR, 4-40 X 5/8, PHI	0
5826-10	FOOT PAD, BOT CVR	4
284252	SCREW, 4-40 X 3/8L	0
161067	TAPE, CL CELL, POLYC	0
608128	CABLE CLAMP. .312 DI	1
608001	CABLE TIE, .094 X 3.	0
5760-16	L FOOT, KCKSTND	2

Item Nbr	Description	Quantity
5761-16	R FOOT, KICKSTND	2
400024	BATTERY, 12VDC, 2.3A	1
515005	FUSE, 1A, 250V, SB	2
510016	SWITCH, ROTARY ENCDR	1
2763-01	DIGITAL BD ASSY	1
600079	RIBBON CABLE, 20 PIN	1
600078	RIBBON CABLE, 24 PIN	1
600080	RIBBON CABLE, 40 PIN	2
482610	EL DISPLAY, THIN FIL	1
9335-10	GASKET, PCB	1
9336-10	KICKSTAND	2
9337-10	GASKET, DISPLAY	1
9486-16	REAR PANEL	1
9487-16	TOP COVER	1
9488-16	BOTTOM COVER	1
9489-16	MAIN FRAME	1
9490-16	BEZEL	1
9306-27	SILICONE KEYPANEL	1
2764-01	POWER BD ASSY	1
2765-01	ANALOG BOARD ASSY	1
2766-01	CO2 INPUT BOARD ASSY	1
9379-01	FAN & BTRY HARN ASSY	1
9392-01	PUMP W RSVR ASSY	1
210157	PWR ENTRY MODULE	1
9419-01	CABLE ASSY, PWR ENTR	1
9420-01	CABLE ASSY, DC PWR,	1
286005	SCR, 6-32 X 1/4L, PA	0
286006	SCR, 6-32 X 5/16L, P	0
285051	WASHER, .500 DIA X .	0
284007	SCR, 4-24 X 1L, PAN	0
284008	SCR, 4-24 X 5/16L, P	0
284009	SCR, 4-24 X 1/4L, PA	0
280244	STANDOFF, 1/4 HEX X	0
280245	STANDOFF, 1/4 HEX X	0
280246	STANDOFF, .18DIA X 1	0
286010	SCR, 6-32 X 4 3/4L	2
400056	PWR SUPPLY, 15 VDC	1
286011	SCR, 6-20 X 5/16L	0
286012	SCR, 6-32 X 3/4L	0
9492-01	KNOB ASSY	1
216074	CONNECTOR, PLUG, POT	1
216077	TERMINAL LUG, RING,	1
161082	TAPE, UHMW POLYETHYL	0
216077	TERMINAL LUG, RING,	2

Item Nbr	Description	Quantity
161098	TAPE, KAPTON, 3/8 W	0
608126	TUBING, HEAT SHRINK,	0
180065	FERRITE, SPLIT CORE	4
9859-01	GROUND WIRE ASSY	1
9490-11	BEZEL MODIFICATION	1
608135	TENSION CLIP	1

11.4 2763-01 Digital Board Assy

Item Nbr	Description	Quantity
154106	CAPACITOR, 22PF, 50V	5
486037	IC, HM628128LFP-12SL	2
180034	FERRITE FILTER, 4 LI	2
474222	RESISTOR, 10 OHM	3
486790	IC, TLE2O22CD, DUAL	1
154069	CAPACITOR, 4.7UF	1
180029	INDUCTOR, 50MHZ CUT-	5
180030	INDUCTOR-CAP, 4700PF	1
474242	RESISTOR, 249K OHM,	1
486314	IC, MC74HC541DW, OCT	2
486348	IC, MM74HC4O4OM	1
474227	RESISTOR, 1K OHM	5
153006	CAPACITOR, 47PF, 63V	1
486042	IC, AT93C66-1OSC	1
154112	CAPACITOR, .O47UF	3
483019	TRANSISTOR, MMBT29O7	1
474247	RESISTOR, 1OM OHM	1
482551	LED, RED, WITH LENS	1
230024	CRYSTAL, 32.768 KHZ	1
486320	IC, SN74HC14D, HEX	1
474231	RESISTOR, 4.99K OHM	2
474240	RESISTOR, lOOK OHM	8
481546	DIODE, SWITCHING	2
487094	IC, RTC-62423, REAL	1
474194	RESISTOR, 2.2M OHM	1
180035	FERRITE FILTER,	3
180022	INDUCTOR, 1OUH, 10%	1
487132	IC, TL7757CPK, SPLY	1
487114	IC, MC34119D, AUDIO	1
515087	FUSE W FUSEHOLDER	1
486481	IC, TLC562OCD, QUAD	1
211213	CONNECTOR, 2 PIN	1
474224	RESISTOR, 100 OHM	44

Item Nbr	Description	Quantity
154072	CAPACITOR, .1UF, 5OV	2
154079	CAP, 1OUF, 25V, 20%	3
216029	TEST POINT, SPRING L	1
154116	CAPACITOR, 1OUF, 35V	6
211327	CONNECTOR, 3 PIN	1
474225	RESISTOR, 499 OHM	1
513010	SWITCH, SLIDE, SPDT	1
474236	RESISTOR, 33.2K OHM,	2
474235	RESISTOR, 24.9K OHM	3
486323	IC, SN74HC573DW, OCT	3
487138	IC, GRAPHICS LCD CON	1
486365	IC, MICROCONTROLLER	1
154119	CAP, 6.8PF, 5OV, 5%	6
474313	RES PACK, 10K OHM	3
474316	RES PACK, lOOK OHM	1
212543	CONNECTOR, 20 PIN	1
180062	FERRITE BEAD, 1K OHM	1
486367	IC, DECADE COUNTER	1
486055	IC, HM628512ALFP-7SL	2
2763-02	FAB, DIGITAL BOARD	1
2763-03	SCHEM, DIGITAL BD	0
515094	FUSE WITH FUSEHOLDER	1
212610	CONN, 24 PIN, HEADER	1
210156	CONNECTOR, 96 PIN	1
9428-07	PROGRAM, CPLD	1
9569-07	PRGM, B CODE & SYS	1
474233	RESISTOR, 10K OHM	25
154105	CAPACITOR, 47PF, 50V	1
154108	CAPACITOR, 100PF, 50	4
154104	CAPACITOR, .O1UF, 50	30
474311	RES PACK, 51 OHM	6
212544	CONNECTOR, 20 PIN	1
180056	FERRITE BEAD, 120 OHM	1
485532	TRANSISTOR, 2N7002T1	2
212611	CONNECTOR, 24 PIN	1
484529	VOLTAGE REGULATOR	1
472140	RESISTOR, 332K OHM,	1
153012	CAPACITOR, 22PF	1
474256	RESISTOR, ZERO OHM,	1
606804	WIRE, SOLID, 26AWG	0
608009	TEFLON TUBING	0

11.5 2764-01 Power Board Assy

Item Nbr	Description	Quantity
487100	IC, TC1426COA, INV D	1
474245	RESISTOR, 1M OHM, 1/	5
606402	WIRE, BUS, 26AWG	0
481557	DIODE, MBRS1100T3, S	2
484557	VOLT RGLR, LT1117CST	1
154106	CAPACITOR, 22PF, 5OV	1
154110	CAPACITOR, 3.3NF, 50	1
486325	IC, MC14O93BD, QUAD	1
154111	CAPACITOR, .1UF, 16V	4
486825	IC, LMC71O1BIM5X, OP	2
486346	IC, TC7SOOFTE8SL, 2-	2
608022	TEFLON TUBING	0
474233	RESISTOR, 10K OHM, 1	30
212307	CONN, 15 PIN, D-SUBM	1
474222	RESISTOR, 10 OHM, 1/	5
154093	CAPACITOR, 68UF, l6V	2
481549	DIODE, MBRS14OT3, RH	5
152096	CAPACITOR, 220UF, 35	12
486790	IC, TLE2O22CD, DUAL	2
486340	IC, TLC2543CDW, 12 B	1
515088	FUSE W FUSEHOLDER, 1	1
484061	TRANSISTOR, MMBT2222	5
180030	INDUCTOR-CAP, 4700PF	4
474265	RESISTOR, 1 OHM, 1/4	1
481555	DIODE, MMBD7000LT1,	11
486314	IC, MC74HCS41DW, OCT	1
474227	RESISTOR, 1K OHM	27
474172	RESISTOR, 10 OHM	1
484565	IC, LT117OCQ, VOLTAG	1
474260	RESISTOR, 121K OHM	2
474220	RESISTOR, ZERO OHM	1
154105	CAPACITOR, 47PF, 5OV	4
486326	IC, MC14O13BD, DUAL	1
471400	RESISTOR, IOOM OHM	1
474259	RESISTOR, 15K OHM, 1	1
485546	TRANSISTOR, VNO6OST	2
154103	CAPACITOR, .OO1UF	3
154112	CAPACITOR, .O47UF	11
483019	TRANSISTOR, MMBT29O7	1
487104	IC, TC44O4COA, DUAL	1
484541	VOLTAGE REGULATOR, L	1
485541	TRANSISTOR, S14947DY	4

Item Nbr	Description	Quantity
180045	INDUCTOR, 22OUH, 20%	2
474228	RESISTOR, 1.21K OHM,	1
486796	IC, TLC2272CD, DUAL	1
472075	RESISTOR, 1M OHM, 1/	1
474247	RESISTOR, 1OM OHM	1
486805	IC, LM393M, DUAL VOL	2
486785	IC, LP339M, QUAD VOL	1
486320	IC, SN74HC14D, HEX S	2
515085	FUSE W FUSEHOLDER	2
481046	DIODE, ZENHR, MMSZ52	1
474231	RESISTOR, 4.99K OHM	1
154086	CAPACITOR, 4.7UF, 10	2
481546	DIODE, SWITCHING, SU	5
481547	DIODE, BAT54, HOT CA	6
180035	FERRITE FILTER, 8 LI	1
484062	TRANSISTOR, MMBT2369	1
484562	IC, LT1175CS8-ADJ	1
484563	VOLT RGLTR, LT1117CS	1
484543	VOLTAGE REGULATOR, M	1
180022	INDUCTOR, 1OUH, 10%	3
486821	IC, AD822AR, FET-IN	1
180047	INDUCTOR, 50 OHMS	8
474230	RESISTOR, 3.32K OHM	2
210070	CONN, 96 PIN, RCPT	1
485543	TRANSISTOR, MOSFET	2
153045	CAPACITOR, .47UF	1
481556	DIODE, MMBD354LT1	1
474198	RESISTOR, 2.49K OHM	4
154108	CAPACITOR, 100PF, 50	3
472030	RESISTOR, 10K OHM	1
486781	IC, TLO72CD, OP AMP	1
486481	IC, TLCS62OCD, QUAD	1
486813	IC, TLC2274AID, QUAD	1
481552	DIODE, MBRS34OT3, SC	6
6756-10	TRANSFORMER, MAIN 30	1
474224	RESISTOR, 100 OHM	10
154072	CAPACITOR, .1UF, 5OV	9
180019	INDUCTOR, 100uH, 10%	1
474193	RESISTOR, 8.87K OHM	1
154104	CAPACITOR, .O1UF	48
481548	DIODE, EGL41B, RHCTI	4
486828	IC, LT146OHCS3-2.5	2
211411	CONNECTOR, PLUG	1
486321	IC, SN74HC138D, 3-LI	2

Item Nbr	Description	Quantity
486313	IC, MC14O66BD, QUAD	1
154079	CAP, 1OUF, 25V, 20%	4
216029	TEST POINT, SPRING L	6
154116	CAPACITOR, 1OUF, 35V	16
474234	RESISTOR, 20.5K OHM	2
487103	IC, TC44O5COA, DUAL	1
481036	DIODE, ZENER, 1N5366	1
474195	RESISTOR, 511K OHM	7
212108	CONNECTOR, 10 PIN	1
485532	TRANSISTOR, 2N7002T1	11
152065	CAPACITOR, 1OUF, 25V	2
474236	RESISTOR, 33.2K OHM	5
486323	IC, SN74HC573DW	2
486363	IC, QUAD UNIV ASYNCH	1
486364	IC, 8 BIT A TO D CONV	1
486831	IC, PRECISION 2.5V R	1
154118	CAP, 33PF, 5OV, 5%,	1
474316	RES PACK, lOOK OHM	3
474311	RES PACK, 51 OHM	1
474312	RES PACK, 1K OHM	2
474302	RESISTOR, 150 OHM	1
474303	RESISTOR, 4.3 OHM	1
474304	RESISTOR, 470K OHM	1
474305	RESISTOR, 470 OHM	2
474306	RESISTOR, 26.7 OHM	1
474307	RESISTOR, 3.32 OHM	1
474308	RESISTOR, 5.6 OHM	1
230028	CRYSTAL, 7.3728 MHZ	1
180057	INDUCTOR, 22UH, 20%	1
486369	IC, LT1134ACSW, 4 RS	1
515094	FUSE WITH FUSEHOLDHR	2
213413	CONN, 40 PIN, HEADER	2
484575	VOLT RGLTR, 1.2V-37V	1
211924	CONN, 9 PIN, RCPT	3
2764-02	FAB, POWER BOARD	1
2764-03	SCHHM, POWER BOARD	0
484576	VOLT RGLTR, MICROPWR	1
606812	WIRE, 3OAWG, SOLID	0
474244	RESISTOR, 750K OHM	2
474257	RESISTOR, 1 OHM	1
474320	RESISTOR, 221K OHM	1
154081	CAPACITOR, 100PF	6
474241	RESISTOR, 150K OHM	3
474242	RESISTOR, 249K OHM	4

Item Nbr	Description	Quantity
474229	RESISTOR, 2.05K OHM	4
474238	RESISTOR, 37.4K OHM	4
474240	RESISTOR, lOOK OHM	26
474197	RESISTOR, 49.9K OHM	2
474243	RESISTOR, 324K OHM	2
9330-01	WIRE ASSY	1
152085	CAPACITOR, HLCTLT	2
474256	RESISTOR, ZERO OHM	2
474261	RESISTOR, 7.5K OHM	2
474230	RESISTOR, 3.32K OHM	1
515087	FUSE W FUSEHOLDHR	1
474239	RESISTOR, 75K OHM	1
153063	CAPACITOR, 220PF, 3K	2
474225	RESISTOR, 499 OHM	13
474323	RESISTOR, 110K OHM	1
474329	RESISTOR, 39.2K OHM	1
487145	IC, OPTOCPLR, DUAL	3
487146	IC, ILQ2-X016, OPTO	2
474224	RESISTOR, 100 OHM	12
474235	RESISTOR, 24.9K OHM	5
161098	TAPE, KAPTON, 3/8 W	0
154016	CAPACITOR, .1UF, SOV	1
474342	RESISTOR, 143 OHM	4
474349	RESISTOR, 130 OHM	4
474350	RESISTOR, 200 OHM	4
606804	WIRE, SOLID, 26AWG	0
472114	RESISTOR, 7.5K OHM	2
472043	RESISTOR, 24.9K OHM	2

11.6 2765-01 Analog Board Assy

Item Nbr	Description	Quantity
180067	Ferrite	1
153012	CAPACITOR, 22PF, THRUHOLE	4
475051	POTENTIOMETER, 10K	3
474245	RESISTOR, 1M OHM	7
484545	VOLTAGE REGULATOR	2
154106	CAPACITOR, 22PF, 50V	8
474241	RESISTOR, 150K OHM	9
154111	CAPACITOR, .1UF, 16V	8
486825	IC, LMC71O1BIM5X, OP	1
608022	TEFLON TUBING	0
484544	VOLTAGE REGULATOR	1

Item Nbr	Description	Quantity
487129	IC, CPC15AFH, ABSOLU	1
474233	RESISTOR, 10K OHM	18
180034	FERRITE FILTER, 4 LI	1
474222	RESISTOR, 10 OHM	20
281211	SCREW, NO. 2 X 1/4 L	0
152096	CAPACITOR, 220UF	5
486790	IC, TLE2O22CD, DUAL	4
486340	IC, TLC2543CDW	1
487115	IC, INSTR AMP, LOW P	4
484061	TRANSISTOR, MMBT2222	1
180030	INDUCTOR-CAP, 4700PF	4
474242	RESISTOR, 249K OHM	5
474157	RESISTOR, 511 OHM	4
475042	POTENTIOMETER, 50K	1
474265	RESISTOR, 1 OHM, 1/4	1
481555	DIODE, MMBD7000LT1	25
486314	IC, MC741-IC541DW, OCT	1
474227	RESISTOR, 1K OHM	23
474229	RESISTOR, 2.05K OHM	1
154105	CAPACITOR, 47PF, 50V	2
474238	RESISTOR, 37.4K OHM	1
474259	RESISTOR, 15K OHM	4
486042	IC, AT93C66-1OSC	1
484010	NPN TRANSISTOR 2N39O6	2
250164	FITTING, PRESS-IN PL	1
154103	CAPACITOR, .OO1UF	3
250146	VALVE, SOLENOID, 5V	4
154112	CAPACITOR, .O47UF	38
486829	IC, LTC159OCS, DUAL	1
483019	TRANSISTOR, MMBT29O7	1
484542	VOLTAGE REGULATOR	1
474228	RESISTOR, 1.21K OHM	1
486796	IC, TLC2272CD, DUAL	4
483002	2N39O6 PNP SILICON	1
472058	RESISTOR, IOOK OHM	1
606407	WIRE, 3OAWG, SOLID	0
474175	RESISTOR, 3.92K OHM	2
486805	IC, LM393M, DUAL VOL	1
180056	FERRITE BEAD, 120 OHM	6
487124	IC, ERT-3281, REFLEC	4
486785	IC, LP339M	2
212501	CONNECTOR, 20 PIN	1
474256	RESISTOR, ZERO OHM	6
486324	IC, DG444DY, QUAD	1

Item Nbr	Description	Quantity
474240	RESISTOR, lOOK OHM	42
474261	RESISTOR, 7.5K OHM	3
608129	TUBING, ESTER-BASED	0
474251	RESISTOR, 61.9K OHM	1
250134	FITTING, Y, FOR 1/16	2
154086	CAPACITOR, 4.7UF	2
481546	DIODE, SWITCHING	1
481547	DIODE, BAT54, HOT CA	5
474194	RESISTOR, 2.2M OHM	2
180035	FERRITE FILTER	2
474197	RESISTOR, 49.9K OHM	12
484543	VOLTAGE REGULATOR	1
486821	IC, AD822AR	4
486807	IC, SMPO4ES	1
474230	RESISTOR, 3.32K OHM	2
9024-10	PNEUMATIC JUNCTION	2
485543	TRANSISTOR, MOSFET	1
481556	DIODE, MMBD354LT1	2
474239	RESISTOR, 75K OHM	8
486332	IC, AD7703BR, 20-BIT	2
474198	RESISTOR, 2.49K OHM	2
154108	CAPACITOR, 100PF	2
250109	FITTING, THE	2
486481	IC, TLC562OCD, QUAD	1
250151	VALVE, SOLENOID, 5V	2
211213	CONNECTOR, 2 PIN	1
474224	RESISTOR, 100 OHM	27
160030	TUBING	0
154072	CAPACITOR, .1UF, 5OV	15
474223	RESISTOR, 49.9 OHM,	8
154104	CAPACITOR, .O1UF, 50	76
481548	DIODE, HGL41B	3
484540	VOLTAGE REGULATOR	1
485540	MOSFET, SI9945D	4
154079	CAP, 1OUF, 25V, 20%	11
216029	TEST POINT, SPRING	16
154116	CAPACITOR, 1OUF, 35V	7
474234	RESISTOR, 20.5K OHM	2
211327	CONNECTOR, 3 PIN	1
474225	RESISTOR, 499 OHM	4
474243	RESISTOR, 324K OHM	2
474195	RESISTOR, SilK OHM	1
485532	TRANSISTOR, 2N7002T1	3
474236	RESISTOR, 33.2K OHM	2

Item Nbr	Description	Quantity
474235	RESISTOR, 24.9K OHM	8
250169	FILTER, INLINE	4
486366	IC, DIGITAL POT, 10K	1
487136	IC, PRESSURE XDCR	1
487137	IC, PRESSURE SENSOR	1
486832	IC, PRECISION 5V REF	1
486831	IC, PRECISION 2.5V R	1
486362	IC, 20 BIT A TO D CONV	1
474316	RES PACK, lOOK OHM	1
474310	RES PACK, 10K OHM	1
486833	IC, 4-INPUT & OUTPUT	1
213414	CONN, 40 PIN, HDR	2
2765-02	FAB, ANALOG BOARD	1
9270-16	FL CONN, RCPT, 3 PT	1
9272-16	SEAL FL CONN, 7300	1
9328-16	SUPPORT, XDUCER	2
2765-03	SCHEM, ANALOG BD	0
9269-01	SPO2 CONN BRKT ASSY	1
250171	CHECK VALVE, NC	2
284008	SCR, 4-24 X 5/16L	0
154137	CAPACITOR, .0047uF	2
154138	CAPACITOR, .OOluF	6
154139	CAPACITOR, .047uF	1
606812	WIRE, 3OAWG, SOLID	0
154143	CAPACITOR, .OluF, 50	6
281211	SCREW, NO. 2 X 1/4 L	0
250164	FITTING, PRESS-IN PL	1
608129	TUBING, ESTER-EASED	0
250134	FITTING, Y, FOR 1/16	2
9024-10	PNEUMATIC JUNCTION	2
250109	FITTING, TEE	2
160030	TUBING	0
250169	FILTER, INLINE	4
9272-16	SEAL FL CONN	1
9328-16	SUPPORT, XDUCER	2
250171	CHECK VALVE, NC	2
284008	SCR, 4-24 X 5/16L	0
606400	WIRE, BUSS, 22AWG	0
608008	TEFLON TUBING	0
2769-01	DIFF PRESSURE XDCR B	1
154106	CAPACITOR, 22PF, 50V	6
487078	IC, AD712JR	2
474331	RESISTOR, 332 OHM, 1/16 W 1%	1
474343	RESISTOR, 374 OHM, 1/16 W 1%	1

Item Nbr	Description	Quantity
474342	RESISTOR, 143 OHM, 1/16 W 1%	1
474344	RESISTOR, 715 OHM, 1/16 W 1%	1

11.7 2766-01 CO_2 Input Board Assy

Part No.	Description	Quantity
2766-02	FAB, CO2 INPUT BOARD	1
600055	RIBBON CABLE ASSY, 20 PIN	1
212527	CONNECTOR, 20 PIN, RECEPT	1

11.8 9392-01 Pump W Rsvr Assy

Part No.	Description	Quantity
9322-01	RESERVOIR ASSY	1
9397-10	MOUNTING PL, PUMP, 7300	1
161108	FOAM TAPE, 1/32THK x 3/4W	0
211328	CONNECTOR, 3 PIN, RCPT	1
250130	PUMP, DIAPHRAGM, 4.5V	1
250169	FILTER, INLINE, 25 MICRON	1
280192	GROMMET, RIBBED, ISODAMP	2
284009	5CR, 4-24 X 1/4L, PAN HD	0
605001	WIRE, 28AWG, RED, TINNED	0
605007	WIRE, 28AWG, BLACK, TINNED	0
608001	CABLE TIE, .094 X 3.62L	0
608005	TUBING, HEAT SHRINK, 1/16	0
608012	CABLE TIE, SELF-LKG, .094	1
608114	TUBING, TYGON, 3/32 IN	0

12 Test Fixtures

This section documents the test fixtures used in testing the Model 7300.

12.1 5776-48 TB1265 Adapter Cable

Parts list:

7156-10	20pin connector
7153-16	Strain relief ring
7154-16	Connector ring
7157-16	Connector housing, lower
7158-16	Connector housing, upper
2766-01	Input connector board

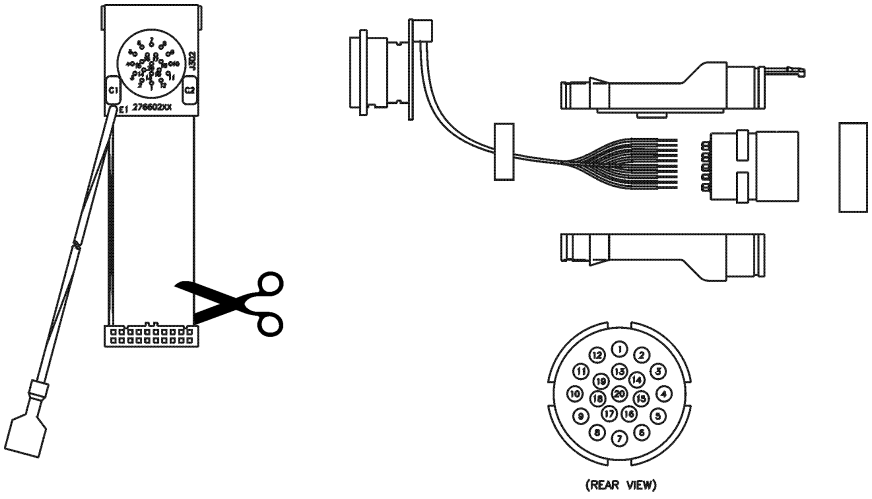
Assembly

1. Cut the header connector from the ribbon cable on the 2766-01 input connector board.
2. Separate, strip and tin each of the ribbon cable wires.
3. Slide the 7153-16 strain relief over the ribbon cable, then solder each of the ribbon cable wires to the 20 pin connector as indicated below. The stripe on the ribbon cable designates pin one. Ensure a good solder connection and no shorting between pins.

Ribbon cable	20 pin connector
1	4
2	6
3	18
4	20
5	15
6	19
7	10
8	17
9	7
10	3
11	11

Ribbon cable	20 pin connector
12	9
13	14
14	12
15	16
16	8
17	13
18	5
19	1
20	2

4. Assemble the 20 pin connector by placing the 7157-16 lower and 7158-16 upper housings together over the 20 pin connector. Snap the 7154-16 connector ring into place, and then the 7153-16 strain relief ring.



12.2 5693-48 Current Limit Test Jack

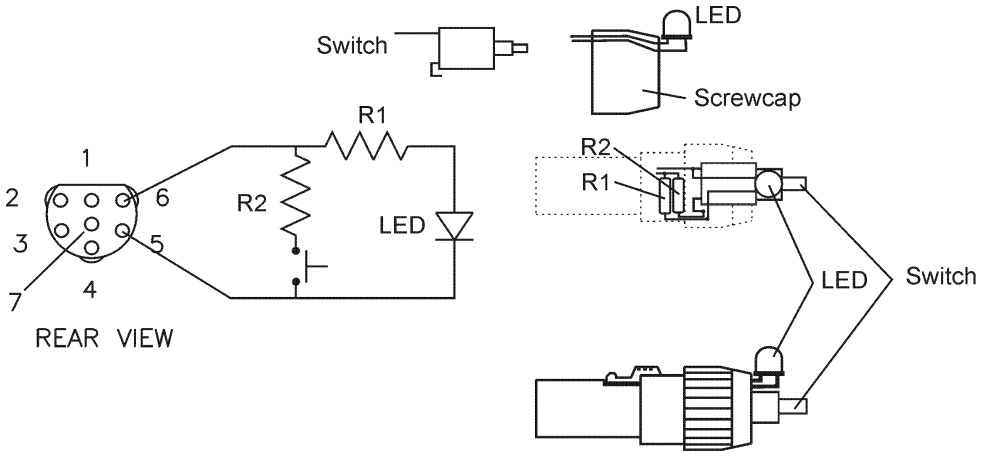
Parts list:

472261	Resistor 33.2 ohm, 1/4 W
472028	Resistor 220 ohm, 1/4W
482500	LED, red
511031	Switch, momentary, SPST, normally open
211705	Connector assembly, 7 pin male

Assembly

1. Bend one lead of the switch as shown. Solder the other lead of the switch to pin 5 of the connector.

2. Solder one end of R2 to the bent pin of the switch, solder the other end to pin 6 on the connector.
3. Bend the leads of the LED to match the contour of the screw cap. Place the LED leads through the screw cap. Solder one lead of R1 to pin 6 of the connector, solder the other lead to the LEDs anode. Solder the cathode of the LED to pin 5 of the connector.
4. Assemble the connector, ensure no shorts. The switch and LED should exit the rear of the connector after the screw cap is set in place. The connector collet is not needed and can be discarded.



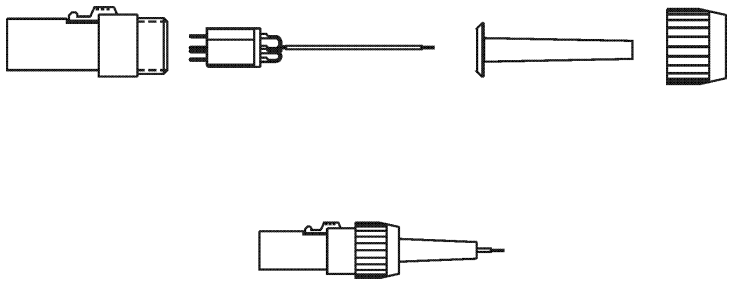
12.3 6573-48 Shorted Saturation Test Jack

Parts list:

211705	Connector assembly
-	18 gauge stranded wire

Assembly:

1. Solder all of the pins on the connector assembly together. Strip and tin a 5” piece of wire and solder one end to the shorted pins.
2. Assemble the connector, the wire should exit the rear of the connector assembly.



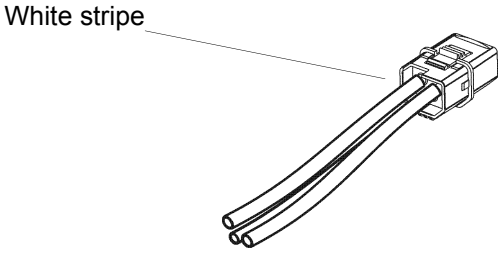
12.4 9636-48 Differential Test Jack

Parts list:

9271-89	3 port connector
9156-10	Triple line tubing 6”
Solvent, 50/50 THF/Cyclohexanone	

Assembly:

1. Separate the triple line tubing approximately 1” from each end.
2. Using the solvent, bond one end of the tubing to the connector, the white strip should align with the left side of the connector.



12.5 9638-48 Common Mode Test Jack

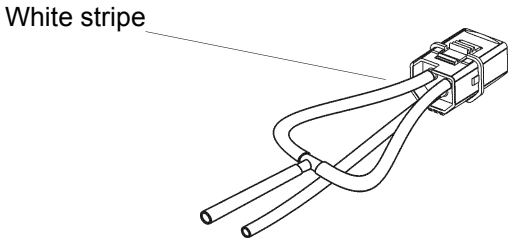
Parts list:

9271-89	3 port connector
9156-10	Triple line tubing 8”
250144	“T” fitting, 3/32 tubing
Solvent 50/50 THF/Cyclohexanone	

Assembly:

1. Separate the triple line tubing approximately 1” from each end.
2. Using the solvent, bond one end of the tubing to the connector, the white strip should align with the left side of the connector. Cut the 3/32” ID tubes from the triple line tubing 4” from the end.

3. Solvent bond the two 3/32” ID tubes from the connector to the “T”, use one of the cut portions of tubing and attach to the remaining port on the “T”.



12.6 9645-48 Plug Test Fixture

Parts list:

250164	Plug, 1/16 ID tubing
160030	1/16” ID tubing 5”

Assembly:

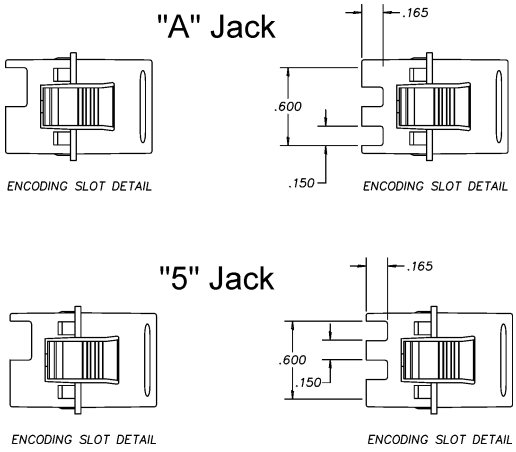
1. Insert the plug into one end of the tubing.

12.7 9635-14, 9635-48 Optical Encoder Test Jacks

Parts list

9271-89	3 port connector Qty: 2
Solvent 50/50/Cyclohexanone	

1. The encoding section of the connector needs to be modified by cutting a portion of the plastic from the connector and reattaching it in a specific location. The left illustration in each case is the original connector, the right illustration portrays the necessary modifications.



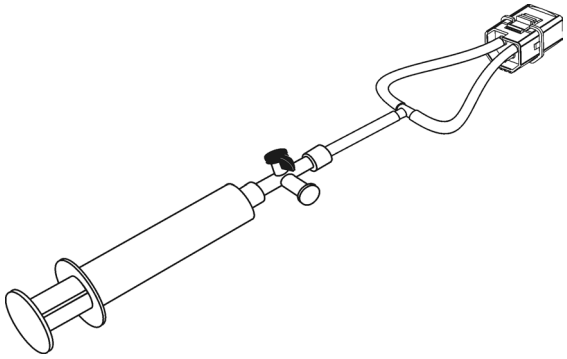
12.8 9695-48 Leak Test Adapter

Parts list:

9271-89	3 port connector
9156-10	triple line tubing
-	Value Plastics tee reduction connector with 2000 series barbs, 3/32” and 1/8” ID tubing PN: T220/230-1
608106	Tubing, 1/8” ID
250086	Fitting, plug w/taper
250150	Stop cock, 3 way, Luer adapter
315095	Syringe, 5cc, Luer lock

Assembly:

1. Separate the triple line tubing.
2. Solvent bond two 3/32” tubing sections from the triple line tubing to the top 3 port connector ports.
3. Attach these tubes from the connector using the tee. Attach the 1/8” tubing from the tee to the Luer fitting.
4. Connect the stop cock between the Luer fitting and the syringe.



13 *Drawings*

Number	Title
9226-00	Non-Invasive Cardiac Output Monitor, 7300
9226-09	Overall Wiring Diagram
9226-01	Main Assembly, Model 7300 - NICO® (6 sheets)
2763-01	Digital Board Assy, Model 7300 - NICO® (2 sheets)
2763-03	Schematic, Digital Bd, Model 7300, NICO® (3 sheets)
2764-01	Power Board Assy, Model 7300 - NICO® (3 sheets)
2764-03	Schematic, Power Board, Model 7300, NICO® (6 sheets)
2765-01	Analog Board Assy, Model 7300 - NICO® (3 sheets)
2765-03	Schematic, Analog Board, Model 7300, NICO® (5 sheets)
2766-01	CO_2 Input Board Assy, Model 7300 - NICO®
2766-03	Schematic, CO_2 Input Board
9488-01	Bottom Cover Assy, Model 7300

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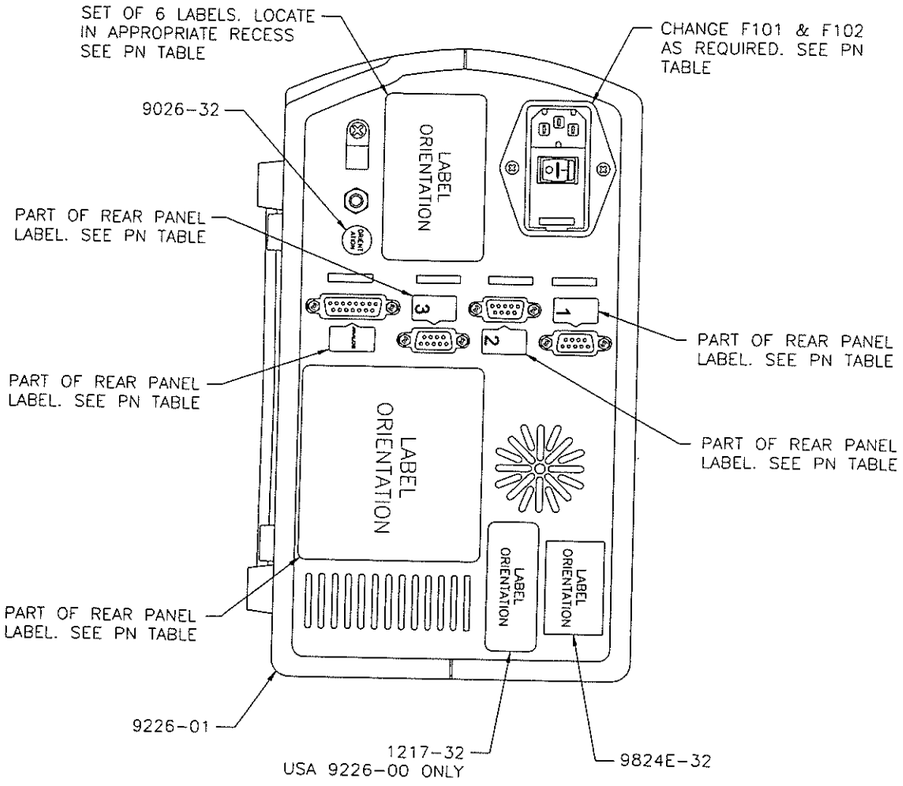
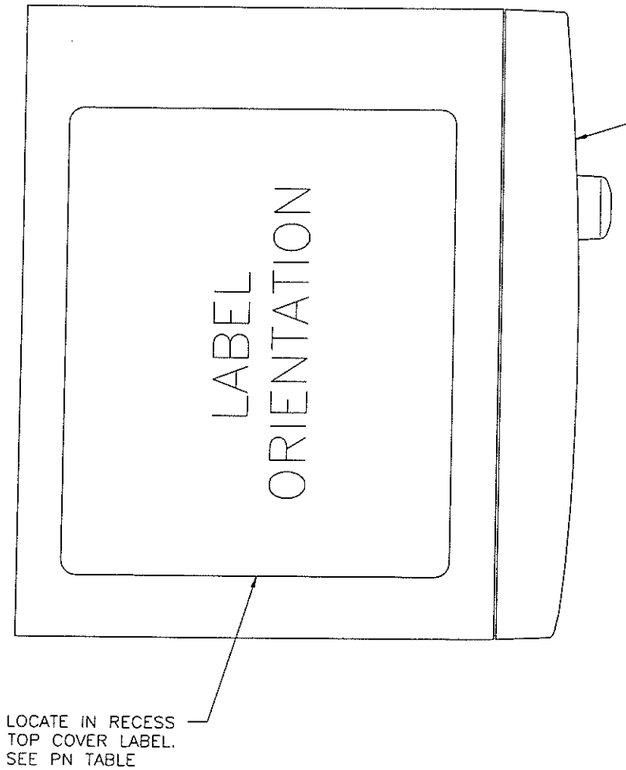
REV	CO NO.	REVISION DESCRIPTION	DFTR	CHKR	RE	DATE
0B	R-N915	SEE REVISION NOTICE	BL	MRL	EPW	10Jul01
0C	R-N942	SEE REVISION NOTICE	RG	MRL	EPW	16Oct01
RD	CR-N3342	RED-LINE CHANGE	~	~	EPW	17Jan02
0E	R-N975	SEE REVISION NOTICE	BL	MRL	EPW	12Feb02
0F	R-N1121	SEE REVISION NOTICE	RG	MRL	EPW	29Aug02
11	R-N1102	SEE REVISION NOTICE	RG	MRL	EPW	2Feb03
12	CO_N0096	ADD NOTE 6	~	~	RT	13Mar03
13	CO_N0322	DEL 1217-32 FROM 9226-ENG2. REPLACE LABEL DETAIL	RG	BL	EPW	23May03
14	CO_N0390	UPDATE REV PER 2765-01 CHANGE	RG	BL	EPW	7/14/03

ORIGINAL


SET OF 6 LABELS. LOCATE IN APPROPRIATE RECESS SEE PN TABLE
CHANGE F101 & F102 AS REQUIRED. SEE PN TABLE
9026-32
PART OF REAR PANEL LABEL. SEE PN TABLE
PART OF REAR PANEL LABEL. SEE PN TABLE
PART OF REAR PANEL LABEL. SEE PN TABLE
PART OF REAR PANEL LABEL. SEE PN TABLE
LABEL ORIENTATION
9226-01
1217-32
USA 9226-00 ONLY
9824E-32



NOTES:
1. 9226-00 MONITOR SHOWN FOR REFERENCE ONLY.
2. FOR QA INSPECTION PROCEDURE SEE 9226-70.
3. FOR OVERALL WIRING DIAGRAM SEE 9226-09.
4. WIPE UNIT CLEAN WITH IPA, ITEM 26 AS APPLICABLE.
5. APPLY LABELS IN ORIENTATION AND LOCATION SHOWN.
6. FOR SHIPPING PACKAGING INSTRUCTIONS SEE 3345-33.

SEE SEPARATE BOM

PN TABLE							
MODEL PN	TOP CVR LABEL	REAR PNL LABEL	USERS MANUAL	FACADE	FUSE	SETTING	LINECORD
9226-00	9487-32	9486-32	9226-23	9501-13	(515005)	115V	600026
9226-ENG2					515095	230V	600041
9226-DAN	9487DAN-32	9486DAN-32	9226DAN-23	9501DAN-13			600042
9226-DUT	9487DUT-32	9486DUT-32	9226DUT-23	9501DUT-13			
9226-FIN	9487FIN-32	9486FIN-32	9226-23	9501FIN-13			
9226-FRE	9487-32	9486FRE-32	9226FRE-23	9501FRE-13	(515005)	115V	600026
9226-FRE2					515095	230V	600042
9226-GER	9487GER-32	9486GER-32	9226GER-23	9501GER-13			
9226-ITA	9487ITA-32	9486ITA-32	9226ITA-23	9501ITA-13			
9226-NOR	9487NOR-32	9486NOR-32	9226-23	9501NOR-13			
9226-POR	9487POR-32	9486POR-32	9226POR-23	9501POR-13			
9226-SPA	9487SPA-32	9486SPA-32	9226SPA-23	9501SPA-13	(515005)	115V	600026
9226-SPA2					515095	230V	600042
9226-SWE	9487SWE-32	9486SWE-32	9226SWE-23	9501SWE-13			

DRAWING TABULATION			
DWG NO.	REV	CO NO.	TITLE
9226-00	13	CO_N0390	100-120V NICO - 7300
9226-ENG2	14	CO_N0390	200-240V NICO - 7300
9226-DAN	13	CO_N0390	DANISH 200-240V NICO - 7300
9226-DUT	13	CO_N0390	DUTCH 200-240V NICO - 7300
9226-FIN	13	CO_N0390	FINNISH 200-240V NICO - 7300
9226-FRE	13	CO_N0390	FRENCH 100-120V NICO - 7300
9226-FRE2	13	CO_N0390	FRENCH 200-240V NICO - 7300
9226-GER	13	CO_N0390	GERMAN 200-240V NICO - 7300
9226-ITA	13	CO_N0390	ITALIAN 200-240V NICO - 7300
9226-NOR	13	CO_N0390	NORWEGIAN 200-240V NICO - 7300
9226-POR	13	CO_N0390	PORTUGUESE 200-240V NICO - 7300
9226-SPA	13	CO_N0390	SPANISH 100-120V NICO - 7300
9226-SPA2	13	CO_N0390	SPANISH 200-240V NICO - 7300
9226-SWE	13	CO_N0390	SWEDISH 200-240V NICO - 7300

DO NOT SCALE DRAWING
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES [mm]
TOLERANCES
.XX ±.01 [.254]
.XXX ±.005 [.127]
.XXXX ±.0025 [.064]
ANG ±1°

THIRD ANGLE PROJECTION

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DRAFTER Michael R. Lindback DATE 16Jan2001
CHECKER MRL DATE
RE E.P.Wigforss DATE 26Sept02

RESPIRONICS®
RESPIRONICS NOVAMETRIX, INC.
HOSPITAL DIVISION

TITLE
NICO - 7300,
CARDIOPULMONARY
MANAGEMENT SYSTEM

SIZE B | PART NUMBER 9226-tab | REV SEE TAB.
SCALE: NONE | SHEET 1 OF 1

PM101
POWER ENTRY MODULE

J104

POWER INPUT
100–120V AC
200–240V AC
50–60 Hz

L
PE
N

S101

G F101 250V SLO–BLO

H F102 250V SLO–BLO

F101 & F102 VALUE
100–120V AC: 1A
200–240V AC: 1/2A

A A
D D
B
C

BRN
BLU

1 L
P1 J1
3 N

J1 P1

F1 3.15A
250V FAST–ACT

T1

PS1
400056

J2
P2

REAR
PANEL

(GND)

A GRN/YEL
B GRN/YEL
GRN/YEL
GRN/YEL

GL101

E2

ISOLATION
BARRIER

B9420-01

P6
J6

J5

F3 2A
125V SLO–BLO

F5
3A
125V
SLO–BLO

F4
3A
125V
SLO–BLO

J7 P7
J9 P9

600080
600080

F6 1A
125V SLO–BLO
F2 2A
125V SLO–BLO
F1 62mA
125V V FAST–ACT

J8 J2

JP1

DIGITAL BOARD
D2763–03

J1

RS232
1
RS232
2
RS232
3
ANALOG

J3
J2
J1
J4

POWER BOARD
D2764–03

CO2 INPUT BOARD
C2766–03

E1

J301

J302

ETCO2
INPUT

P2
J2

B1

PUMP W RESERVOIR
C9392–01

P6 J6

ANALOG BOARD
D2765–03

DIFFERENTIAL PRESSURE
TRANSDUCER BOARD
B2769–03

P1 J1

P3 J3

J4

SpO2
INPUT

J7

J5 P5
600079
P1 J1

EL DISPLAY
482610

J3 P3
600078
P1 J1

KEYPANEL
C9306–27

J2 P2
510016

S1

FRONT
PANEL

J4

BL1

C9379–01

P8 J8

F2 125mA
125V SLO–BLO

P7 J7

F1 3A
125V SLO–BLO

J1

12V DC
BT1

J402 P402
J401 P401

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REV	R NO.	DATE
03	R–N897	25Jul01
02	N786	11Aug00
01	N766	15Jun00

DO NOT SCALE
UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES [mm]
TOLERANCES
.XX ±.01 [.254]
.XXX ±.005 [.127]
.XXXX ±.0025 [.064]
FRAC ±1/64
ANG ±1/4°

☐ SOLID MODEL ON FILE

DRAWN	B. Lancaster	DATE 15Jan99
CHECK	MRL	DATE 25Feb99
MFG ENGR	MJC	DATE 2/24/99
ENGR	J Triunfo	DATE 2/25/99
PROJ ENGR	D R Risch	DATE 2/25/99

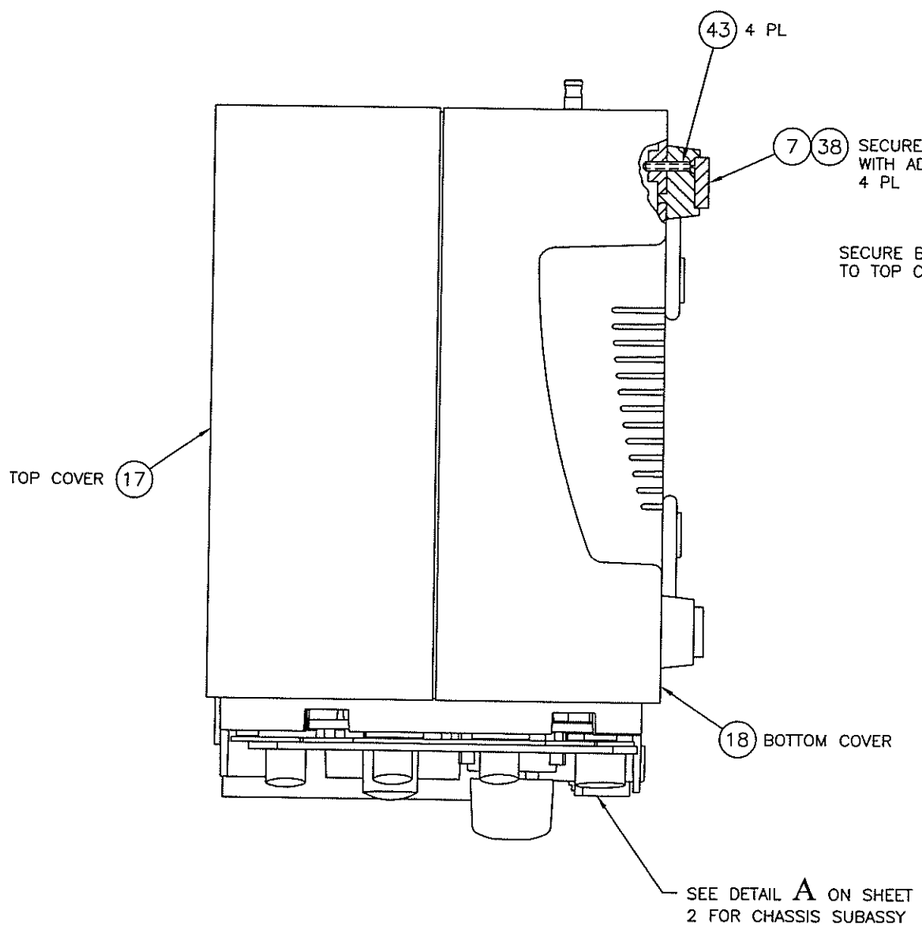
NEXT ASSY: D9226–00

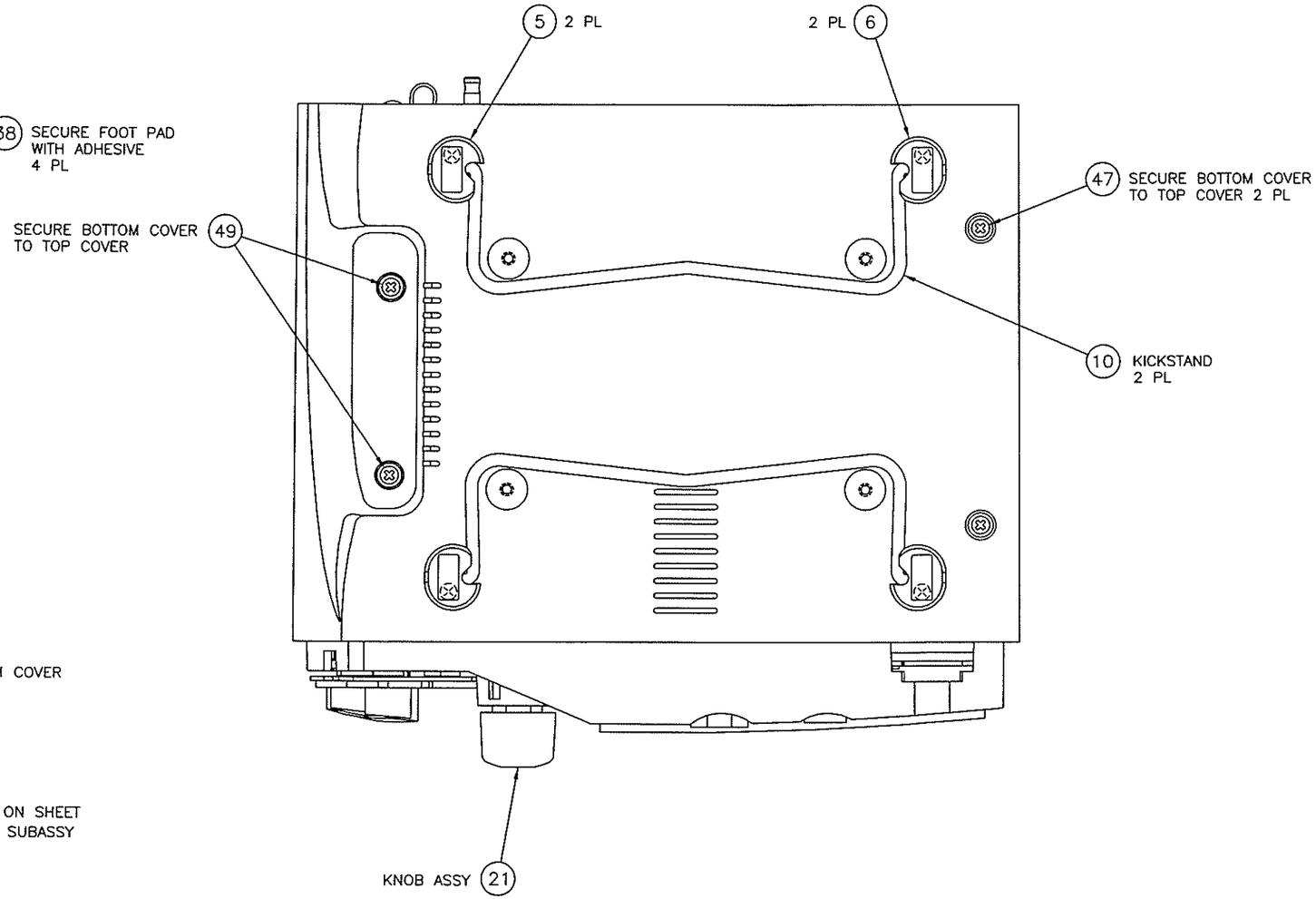
novametrix™ EVERY BEAT, EVERY BREATH, EVERY LIFE

TITLE
OVERALL WIRING
DIAGRAM, 7300

SIZE	DRAWING NO.	CODE	REV
D	9226	09	03

SCALE: NONE SHEET 1 OF 1





NOTES:
1. FOR SYSTEM TEST PROCEDURE SEE A9226-04.
2. FOR OVERALL WIRING DIAGRAM SEE D9226-09.
3. FOR EPOXY MIXING ASSY PROCEDURE SEE A9779-33.

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REV	R NO.	DATE
06	R-N936	25Sep01
R6	CR-N3288	6Sep01
05	N817	10Nov00
04	N786	11Aug00
03	N766	26Jun00
02	N718	25Jan00
01	N678	29Jun99

DO NOT SCALE
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES [mm]
TOLERANCES
.XX ±.01 [.254]
.XXX ±.005 [.127]
.XXXX ±.0025 [.064]
FRAC ±1/64
ANG ±1/4°

☐ SOLID MODEL ON FILE

DRAWN	B. Lancaster	DATE 28Dec98
CHECK	MRL	DATE 19Feb99
MFG ENGR	BN	DATE 18Feb99
ENGR	J SANDOR	DATE 19Feb99
PROJ ENGR	DRR	DATE 2/18/99
NEXT ASSY: D9226-00		

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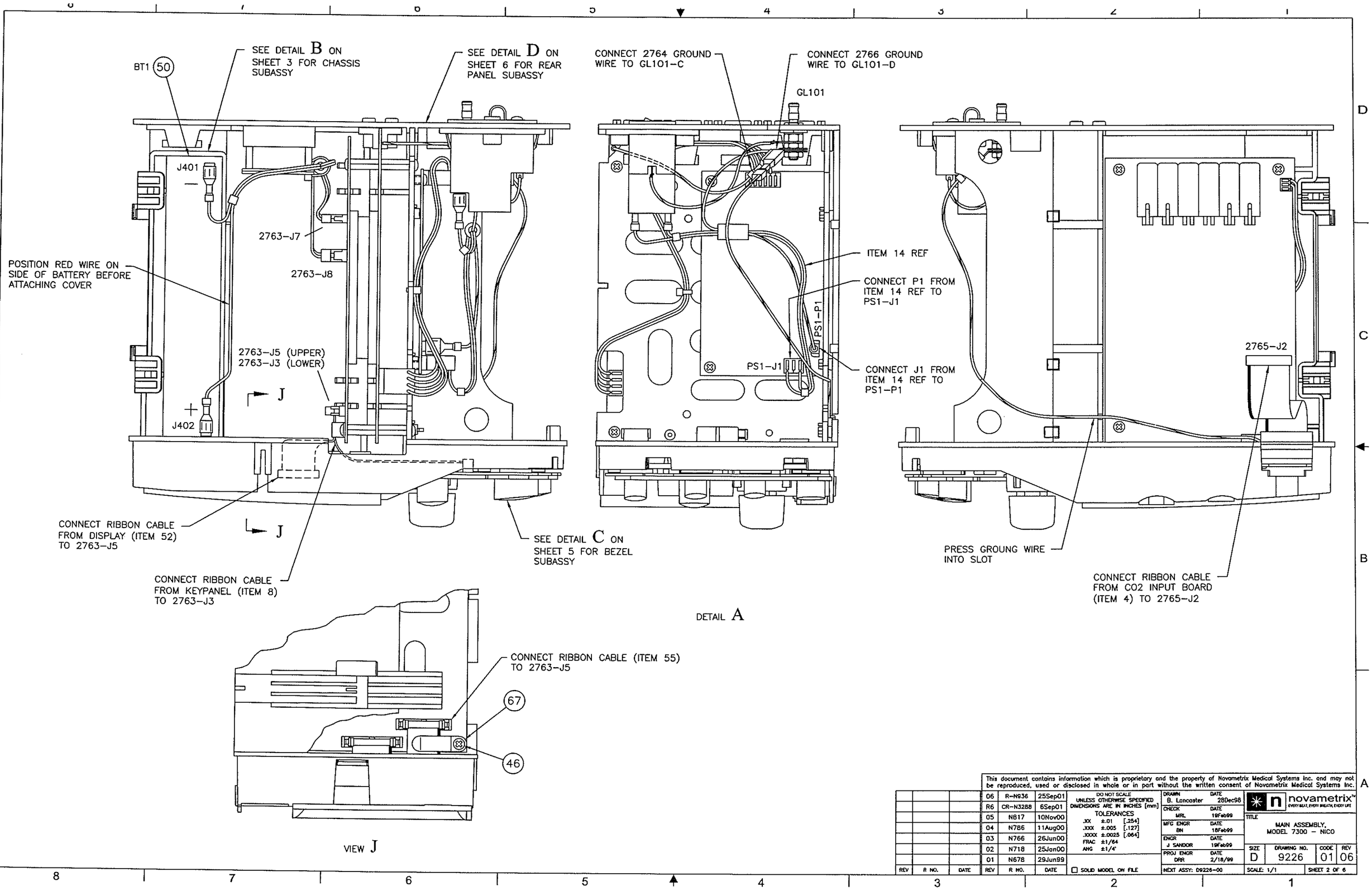
TITLE
MAIN ASSEMBLY, MODEL 7300 - NICO

SIZE	DRAWING NO.	CODE	REV
D	9226	01	06

SCALE: 1/1 SHEET 1 OF 6


BT1
50
SEE DETAIL B ON SHEET 3 FOR CHASSIS SUBASSY
SEE DETAIL D ON SHEET 6 FOR REAR PANEL SUBASSY
J401
2763-J7
2763-J8
POSITION RED WIRE ON SIDE OF BATTERY BEFORE ATTACHING COVER
2763-J5 (UPPER)
2763-J3 (LOWER)
J
J402
CONNECT RIBBON CABLE FROM DISPLAY (ITEM 52) TO 2763-J5
CONNECT RIBBON CABLE FROM KEYPANEL (ITEM 8) TO 2763-J3
SEE DETAIL C ON SHEET 5 FOR BEZEL SUBASSY
CONNECT 2764 GROUND WIRE TO GL101-C
CONNECT 2766 GROUND WIRE TO GL101-D
GL101
ITEM 14 REF
CONNECT P1 FROM ITEM 14 REF TO PS1-J1
PS1-P1
PS1-J1
CONNECT J1 FROM ITEM 14 REF TO PS1-P1
2765-J2
PRESS GROUNG WIRE INTO SLOT
CONNECT RIBBON CABLE FROM CO2 INPUT BOARD (ITEM 4) TO 2765-J2
DETAIL A
CONNECT RIBBON CABLE (ITEM 55) TO 2763-J5
67
46
VIEW J

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REV	R NO.	DATE
06	R-N936	25Sep01
R6	CR-N3288	6Sep01
05	N817	10Nov00
04	N786	11Aug00
03	N766	26Jun00
02	N718	25Jan00
01	N678	29Jun99

DO NOT SCALE
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES [mm]
TOLERANCES
.XX ±.01 [.254]
.XXX ±.005 [.127]
.XXXX ±.0025 [.064]
FRAC ±1/64
ANG ±1/4°

☐ SOLID MODEL ON FILE

DRAWN	B. Lancaster 28Dec98
CHECK	MRL 19Feb99
MFG ENGR	BN 18Feb99
ENGR	J SANDOR 19Feb99
PROJ ENGR	DRR 2/18/99
NEXT ASSY: D9226-00	

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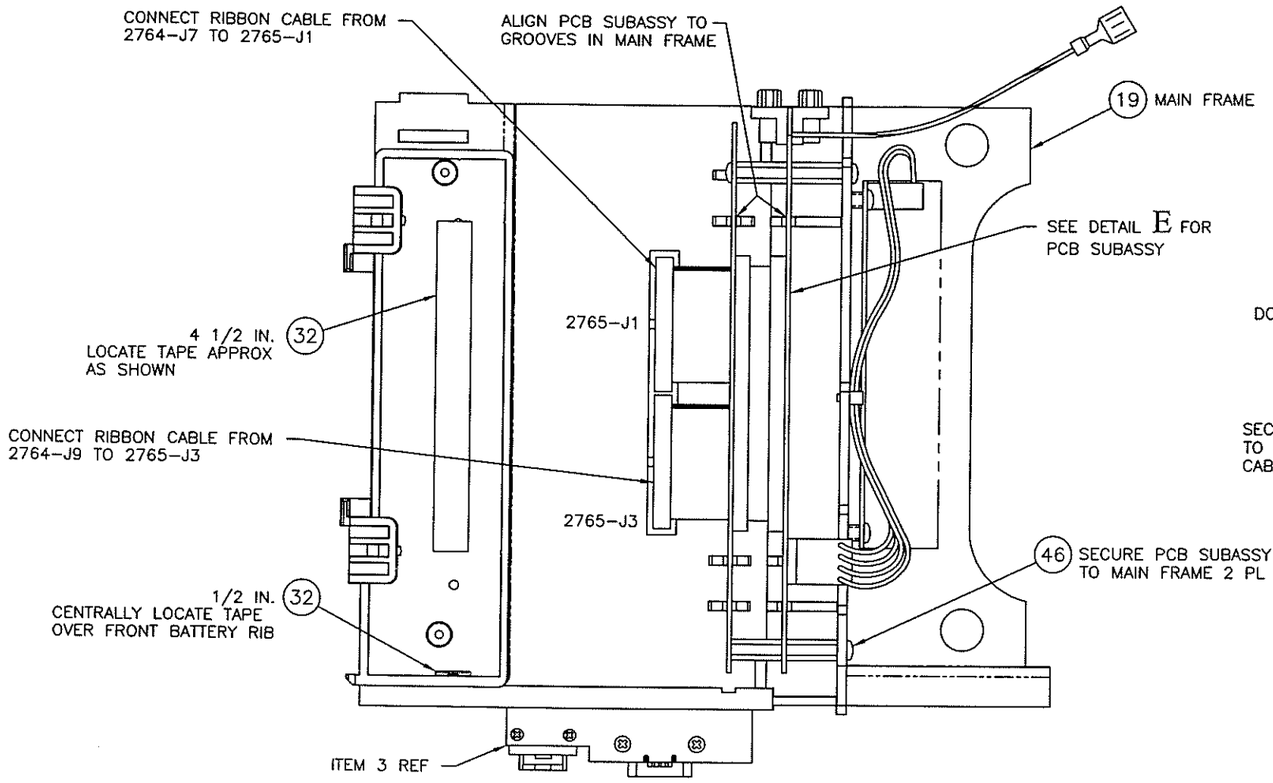
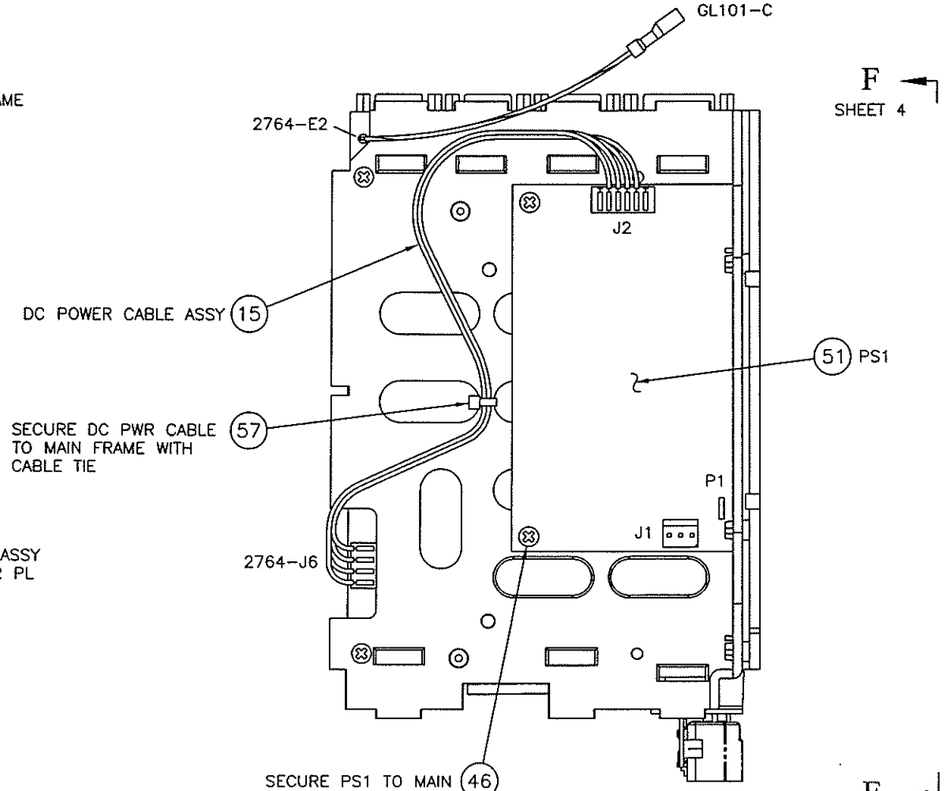
TITLE
MAIN ASSEMBLY, MODEL 7300 – NICO

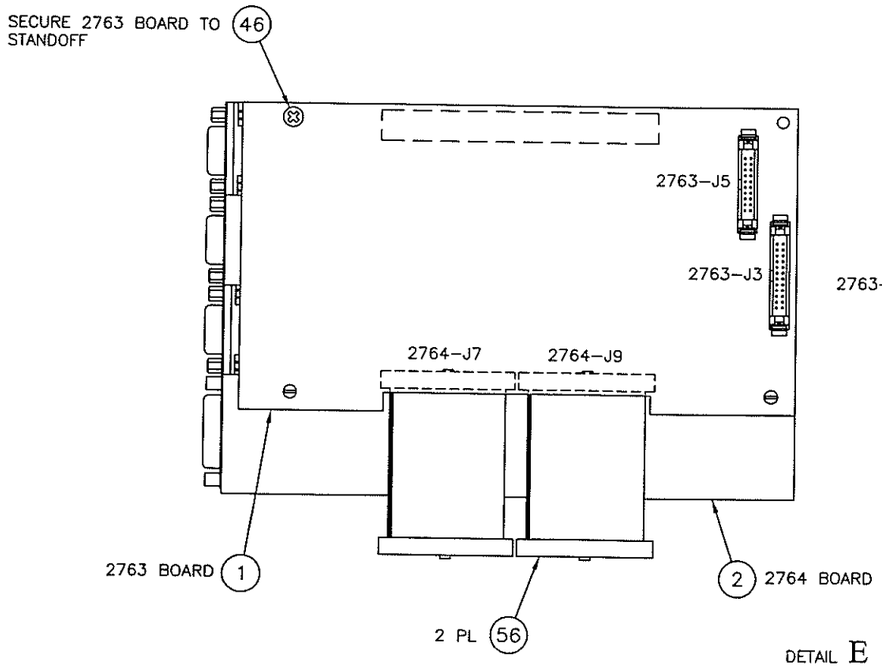
SIZE	DRAWING NO.	CODE	REV
D	9226	01	06

SCALE: 1/1 SHEET 2 OF 6

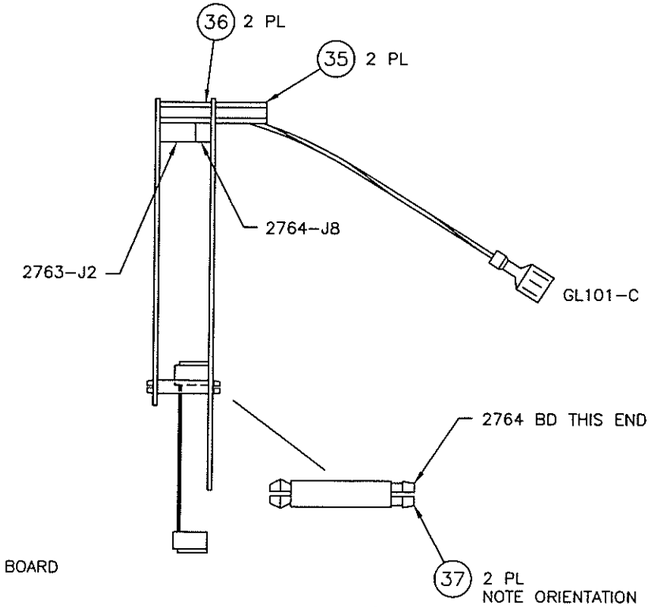

CONNECT RIBBON CABLE FROM 2764-J7 TO 2765-J1
ALIGN PCB SUBASSY TO GROOVES IN MAIN FRAME
19 MAIN FRAME
SEE DETAIL E FOR PCB SUBASSY
4 1/2 IN. LOCATE TAPE APPROX AS SHOWN
32
2765-J1
CONNECT RIBBON CABLE FROM 2764-J9 TO 2765-J3
2765-J3
46 SECURE PCB SUBASSY TO MAIN FRAME 2 PL
1/2 IN. CENTRALLY LOCATE TAPE OVER FRONT BATTERY RIB
32
ITEM 3 REF



DETAIL B



DETAIL E



DETAIL G
SCALE: 2/1

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REV	R NO.	DATE
06	R-N936	25Sep01
R6	CR-N3288	6Sep01
05	N817	10Nov00
04	N786	11Aug00
03	N766	27Jun00
02	N718	25Jan00
01	N678	29Jun99

DO NOT SCALE
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES [mm]
TOLERANCES
.XX ±.01 [.254]
.XXX ±.005 [.127]
.XXXX ±.0025 [.064]
FRAC ±1/64
ANG ±1/4°

☐ SOLID MODEL ON FILE

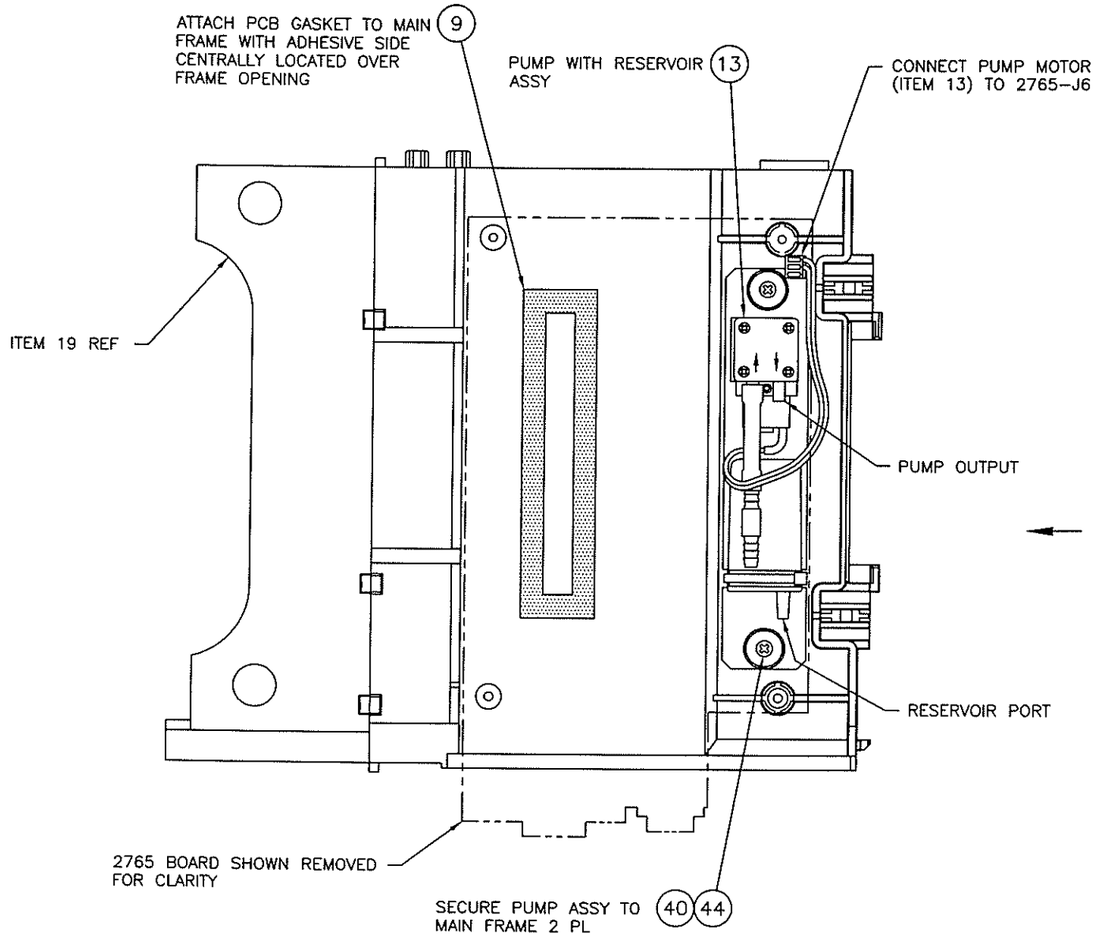
DRAWN	B. Lancaster	DATE 31Dec98
CHECK	MRL	DATE 19Feb99
MFG ENGR	BN	DATE 18Feb99
ENGR	J SANDOR	DATE 19Feb99
PROJ ENGR	DRR	DATE 2/18/99
NEXT ASSY: D9226-00		

novametrix™ EVERY BEAT, EVERY BREATH, EVERY LIFE

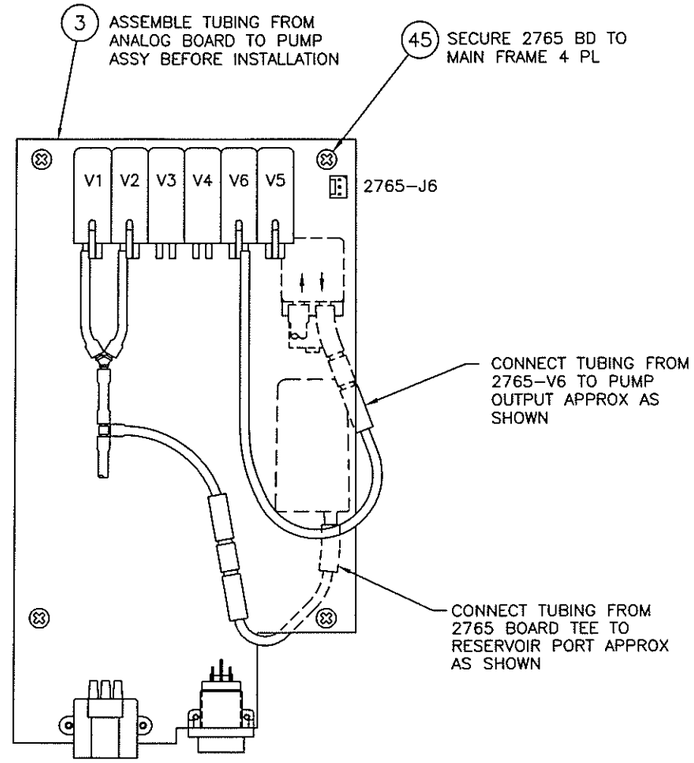
TITLE: MAIN ASSEMBLY, MODEL 7300 - NICO

SIZE	DRAWING NO.	CODE	REV
D	9226	01	06

SCALE: 1/1 SHEET 3 OF 6


ATTACH PCB GASKET TO MAIN FRAME WITH ADHESIVE SIDE CENTRALLY LOCATED OVER FRAME OPENING
9
PUMP WITH RESERVOIR ASSY
13
CONNECT PUMP MOTOR (ITEM 13) TO 2765–J6
ITEM 19 REF
PUMP OUTPUT
RESERVOIR PORT
2765 BOARD SHOWN REMOVED FOR CLARITY
SECURE PUMP ASSY TO MAIN FRAME 2 PL
40
44

VIEW F-F



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ANG ±1/4°

☐ SOLID MODEL ON FILE

DRAWN	B. Lancaster	DATE 31Dec98
CHECK	MRL	DATE 19Feb99
MFG ENGR	BN	DATE 18Feb99
ENGR	J SANDOR	DATE 19Feb99
PROJ ENGR	DRR	DATE 2/16/99

NEXT ASSY: D9226–00

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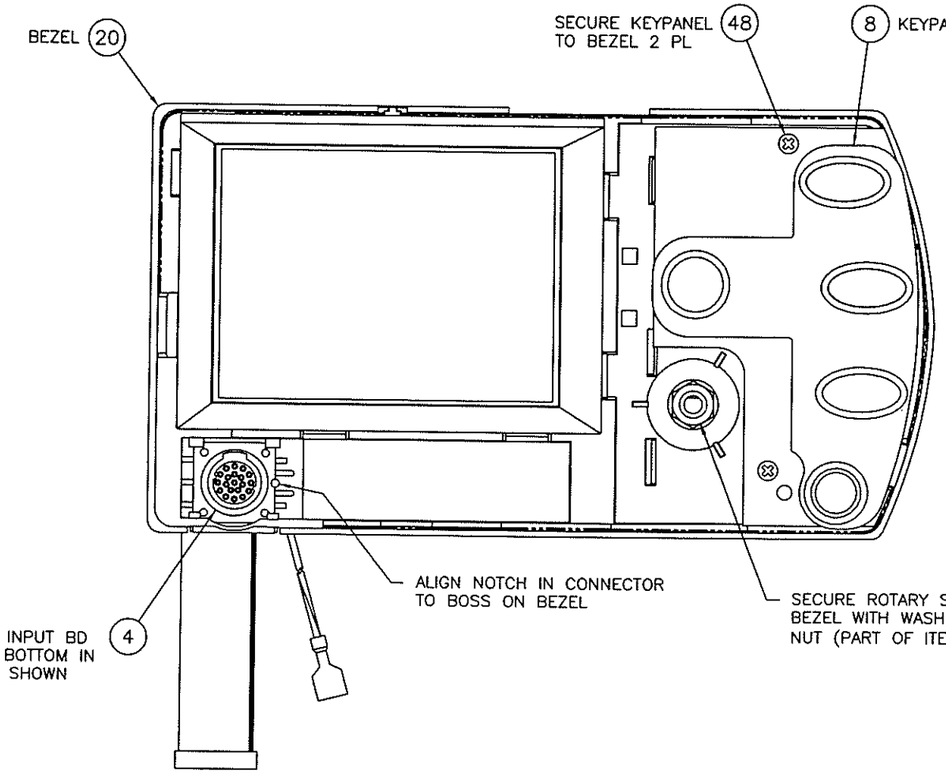
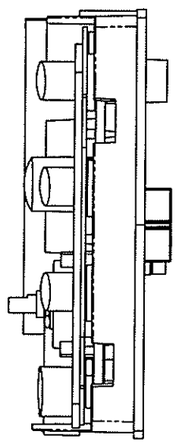
TITLE: MAIN ASSEMBLY, MODEL 7300 – NICO

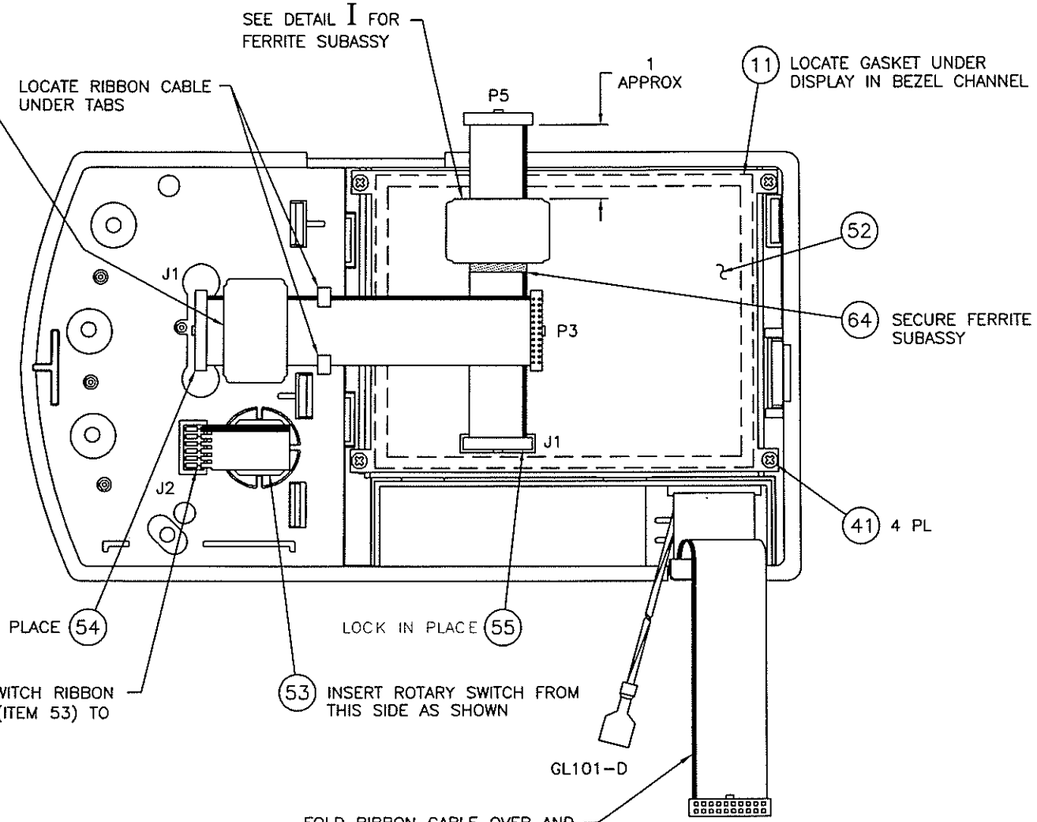
SIZE	DRAWING NO.	CODE	REV
D	9226	01	06

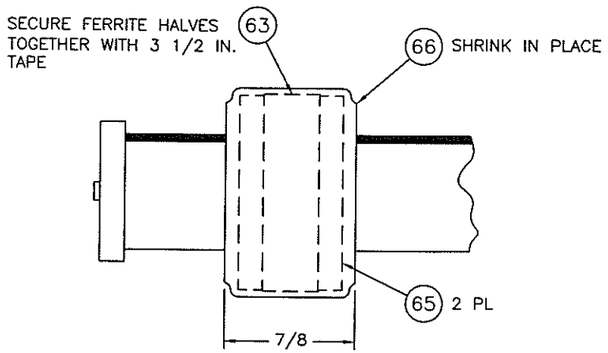
SCALE: 1/1 SHEET 4 OF 6


BEZEL (20)
SECURE KEYPANEL TO BEZEL 2 PL (48)
(8) KEYPANEL
ALIGN NOTCH IN CONNECTOR TO BOSS ON BEZEL
SECURE ROTARY SWITCH TO BEZEL WITH WASHER AND NUT (PART OF ITEM 53)
INSERT CO2 INPUT BD ASSY FROM BOTTOM IN ORIENTATION SHOWN (4)

DETAIL C




SEE DETAIL I FOR FERRITE SUBASSY
LOCATE RIBBON CABLE UNDER TABS
P5
1 APPROX
(11) LOCATE GASKET UNDER DISPLAY IN BEZEL CHANNEL
J1
(52)
(64) SECURE FERRITE SUBASSY
P3
J1
J2
(41) 4 PL
LOCK IN PLACE (54)
LOCK IN PLACE (55)
CONNECT ROTARY SWITCH RIBBON CABLE CONNECTOR (ITEM 53) TO KEYPANEL (ITEM 8)
(53) INSERT ROTARY SWITCH FROM THIS SIDE AS SHOWN
GL101-D
FOLD RIBBON CABLE OVER AND DOWN BEFORE INSTALLING BEZEL TO MAIN FRAME
P2



DETAIL I
SCALE: 2/1

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.XXXX ±.0025 [.064]
FRAC ±1/64
ANG ±1/4°

☐ SOLID MODEL ON FILE

DRAWN	B. Lancaster	DATE 31Dec98
CHECK	MRL	DATE 19Feb99
MFG ENGR	BN	DATE 18Feb99
ENGR	J SANDOR	DATE 19Feb99
PROJ ENGR	DRR	DATE 2/18/99
NEXT ASSY: D9226-00		

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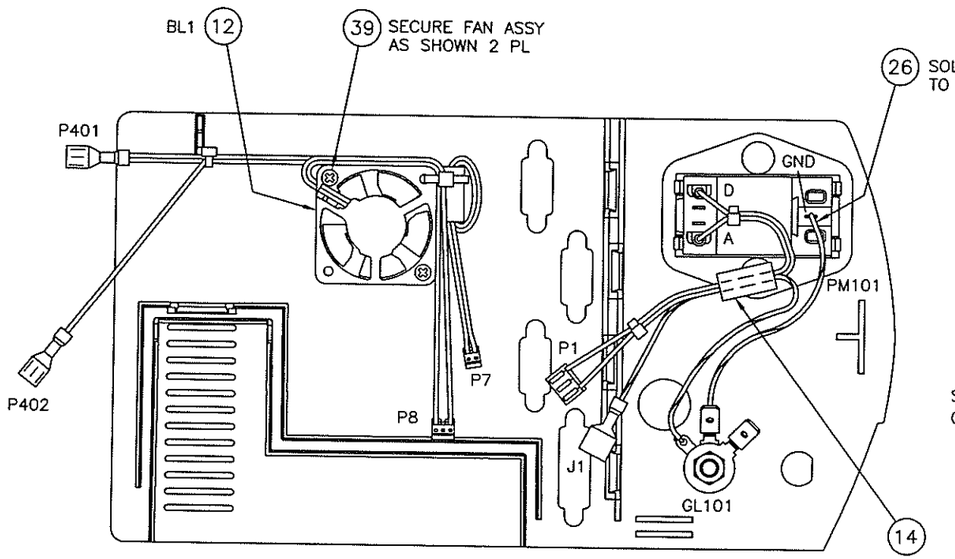
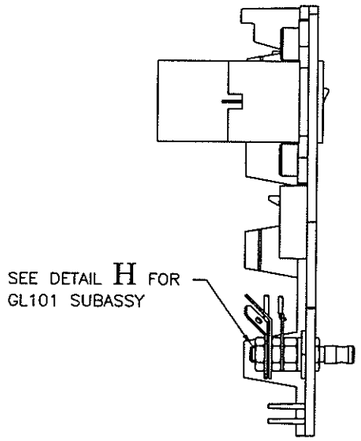
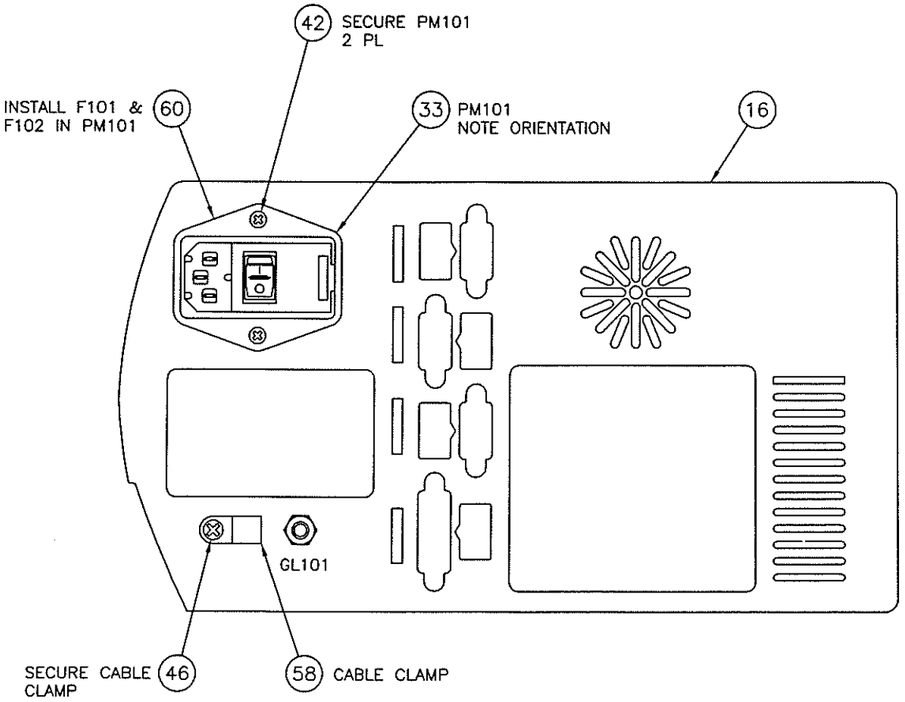
TITLE: MAIN ASSEMBLY, MODEL 7300 – NICO

SIZE	DRAWING NO.	CODE	REV
D	9226	01	06

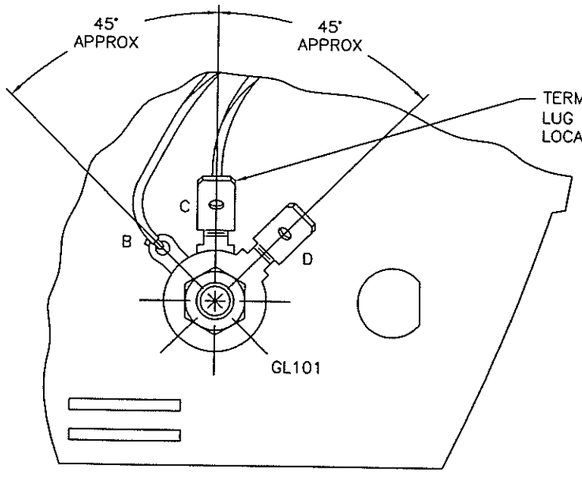
SCALE: 1/1 SHEET 5 OF 6

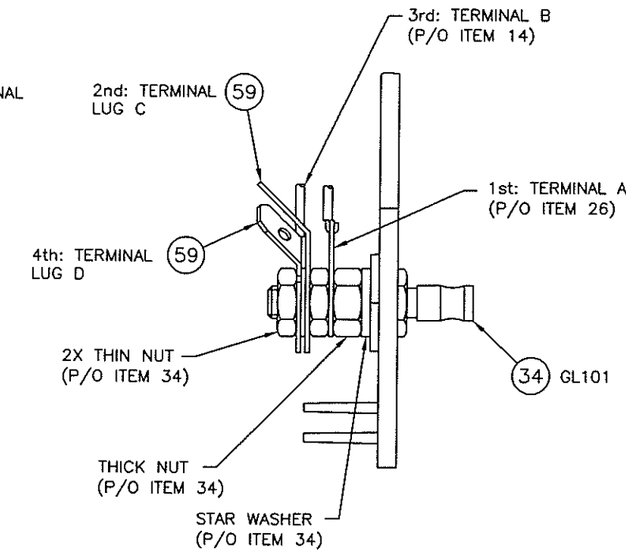






DETAIL D





DETAIL H
SCALE: 2/1

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TOLERANCES
.XX ±.01 [.254]
.XXX ±.005 [.127]
.XXXX ±.0025 [.064]
FRAC ±1/64
ANG ±1/4°

☐ SOLID MODEL ON FILE

DRAWN	B. Lancaster 31Dec98
CHECK	MRL 19Feb99
MFG ENGR	BN 18Feb99
ENGR	J SANDOR 19Feb99
PROJ ENGR	DRR 2/18/99

NEXT ASSY: D9226-00

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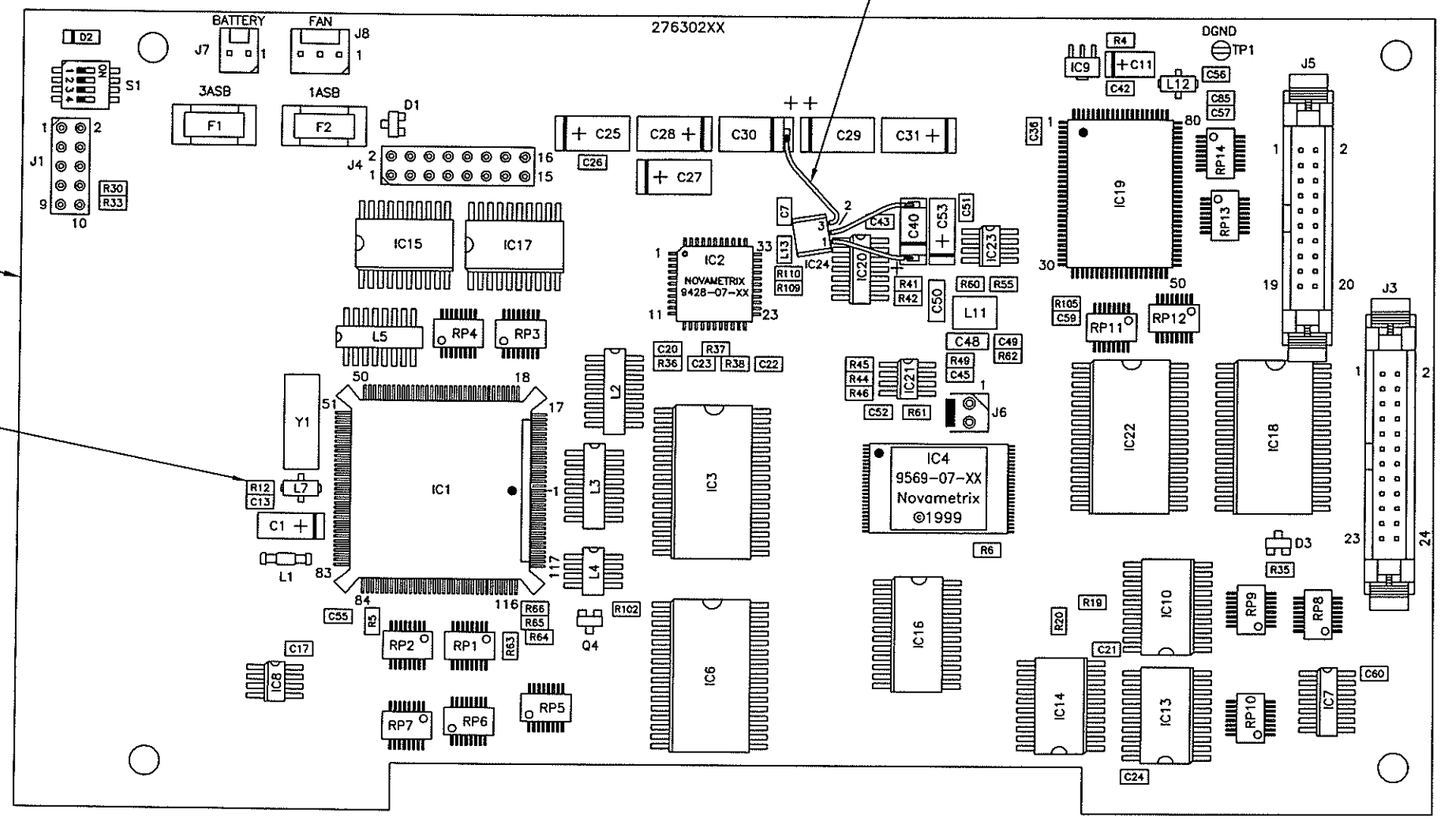
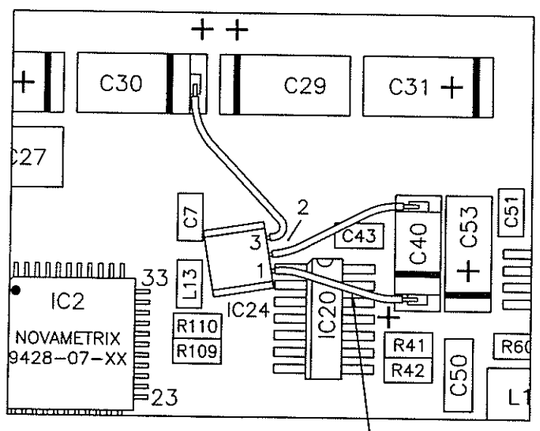
TITLE: MAIN ASSEMBLY, MODEL 7300 – NICO

SIZE	DRAWING NO.	CODE	REV
D	9226	01	06

SCALE: 1/1 SHEET 6 OF 6





12 MOUNT IC24 WITH FLAT SIDE UP AND COVER LEADS AS REQUIRED

DETAIL A
SCALE: NONE

NOTES:

1. FOR TEST PROCEDURE SEE A2763-04.
2. THE FOLLOWING COMPONENTS ARE NOT FITTED: C18, J1, J4, J6, R3, R12, R31, R32, R41, R57, R59, R92, R93, R106, R107

REV	R NO.	DATE
05	R-N915	5Jul01
R5	CR-N3265	26Jun01
04	N814	1Nov00
03	N742	29Mar00
02	N697	1Oct99
01	N660	26Apr99

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TOLERANCES
.XX ±.01 [.254]
.XXX ±.005 [.127]
.XXXX ±.0025 [.064]
FRAC ±1/64
ANG ±1/4°

☐ SOLID MODEL ON FILE

DRAWN	Bob Lancaster	DATE 3Nov98
CHECK	MRL	DATE
MFG ENGR	MJC	DATE 2/9/99
ENGR	RHD	DATE 2/9/99
PROJ ENGR	DRR	DATE 2/9/99
NEXT ASSY: 09226-01		

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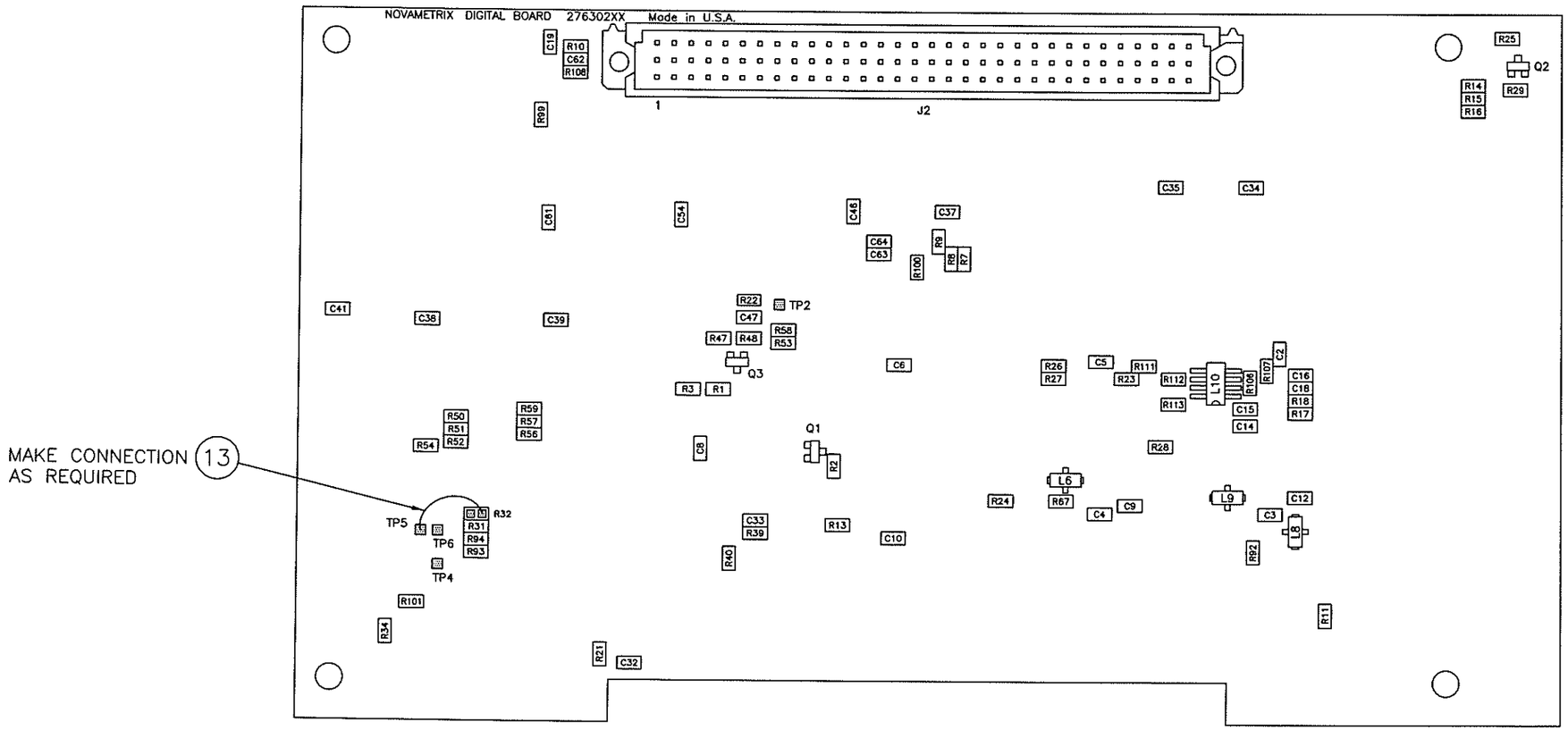
TITLE
DIGITAL BOARD ASSY, MODEL 7300 - NICO

SIZE	DRAWING NO.	CODE	REV
C	2763	01	05

SCALE: 2/1 SHEET 1 OF 2



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TOLERANCES
.XX ±.01 [.254]
.XXX ±.005 [.127]
.XXXX ±.0025 [.064]
FRAC ±1/64
ANG ±1/4°

☐ SOLID MODEL ON FILE

DRAWN	Bob Lancaster	3Nov98
CHECK	MRL	
MFG ENGR	MJC	2/9/99
ENGR	RHD	2/9/99
PROJ ENGR	DRR	2/9/99

NEXT ASSY: 09226-01

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TITLE
DIGITAL BOARD ASSY,
MODEL 7300 – NICO

SIZE	DRAWING NO.	CODE	REV
C	2763	01	05

SCALE: 2/1 SHEET 2 OF 2

D[0..15]
A[0..19]

MVDD
L1 61R30T
VDD
VSS
C1 10u Tant 25V
C2 0.01u
C3 0.01u
C4 0.01u
C5 0.01u

IC1 MC68332
VSTBY
VDD
VSS
T2CLK
TP0
TP1
TP2
TP3
TP4
TP5
TP6
TP7
TP8
TP9
TP10
TP11
TP12
TP13
TP14
TP15
L2
L3
F0818-1SR
CO2AZ
CO2PWENB
SRCDRV0
CO2CSHL
SRCDRV1
CO2SSH
CASEPWM
DETPWM
ASAMPL
RDLEDL
RSAMPL
IRLEDL
ISAMPL
TOUT1
TOUT2
TPU15

LED
SYSUP
CSOFTOT
DSOFTOT
UARTIRQL
EXTDCIN
PWRDWN
NMIL
MODCLK/PF0
IRQ1*/PF1
IRQ2*/PF2
IRQ3*/PF3
IRQ4*/PF4
IRQ5*/PF5
IRQ6*/PF6
IRQ7*/PF7

BERRL
HALTL
BERR*
HALT*
SRSTL
RESET*

SSDI
SSDO
SSCLK
PCS0
PCS1
PCS2
PCS3
ASRxD
L5
F0818-1SR
MISO
MOSI
SCK
PCS0*/SS*
PCS1*
PCS2*
PCS3*
TxD
RxD

SYSCLKO
L14 (R12)
BLM11A121SPT
L7 51R00P
CLKOUT
VDDSYN
C13 100p
C14 0.01u
C15 047u
XFC
C16 22p
R17 Zero Ohm
Y1* 32.768KHz
R18 10M 5%
C86* (C18) 22p
R114* 332k
EXTAL
XTAL

RP1 51
RP2
RP3
RP4
R5 100 A0
R111 100 A16
R112 100 A17
R113 100 A18
C9 100p
R63 100 ROMOEL
R64 100 UBRAMWRL
R65 100 LBRAMWRL
R66 100 SRAMOEL
ROMWRL
UARTCSL
BOOTWE
R67 100
L4
A19
L6
RTCCSL
DISPCSL
VRAMCSL
CASCADEL
SIZ0
L9
L8
ASL
C55 100p
C12 100p
R92 DNP DSL
L10
F0418-1SR
R106 DNP
R107 DNP
WRL
RDL
IC7A 74HC14
R101 100
C60 0.01u

CSBOOT*
BR*/CS0*
BG/CS1*
BACK/CS2*
FC0/CS3*
FC1/CS4*
FC2/CS5*
A19/CS6*
A20/CS7*
A21/CS8*
A22/CS9*
A23/CS10*
SIZ1/PE7
SIZ0/PE6
AS*/PE5
DS*/PE4
RMC*/PE3
AVC*/PE2
DS1*/PE1
DS0*/PE0
R/W*
IPIPE*
IFETCH*
BKPT*
TSTME*
FREEZE
CNFG2
CNFG1
CNFG0
DS1L
DS0L
BKPTL
TSTMEL
FREEZE

VBACK
SRSTL
Q1 2N7002
R2 100K
IC3 HM628512
SRAMOEL
LBRAMWRL
VCC
GND
C6 0.01u
IC6 HM628512
UBRAMWRL
C10 0.01u

ROMWRL
Q4 2N7002
R102 10K
IC4 28F400/800
R6 10
ROMOEL
BYTE
RP
WP
Vpp
Vcc
C8 0.01u
R1 10K
R3 DNP

VDD
R4 100
IC9 TL7757CPK
VDD
RST*
GND
C11 4.7u Tant 16V
C19 0.047u
IC7B 74HC14
RESET
SRSTL
C62 47p

OBEECS
IC8 93C66
SSCLK
SSDO
SSDI
CS
SK
DI
DO
DC
ORG
C17 0.01u

SRSTL
SSDI
BYTEL
CNFG0
CNFG1
CNFG2
R10 1K
R11 1K
R13 100K
R14 100K
R15 100K
R16 100K

RP5 10K
RP6 10K
RP7 10K
T2CLK
CO2AZ
CO2CSHL
CO2SSH
ASAMPL
RSAMPL
RDLEDL
IRLEDL
ISAMPL
TOUT1
TOUT2
TPU15
LED
CSOFTOT
DSOFTOT
TSTMEL
ROMOEL
SRAMOEL
HALTL
BERRL
D0
D1
D2
D4
D5
D6
D7
D10
D11
EXTDCIN
UARTIRQL
NMIL
BKPTL
SSDO
SSCLK
PCS0
PCS1
PCS2
PCS3
ASRxD
DS0L
DS1L
ASL
DSL

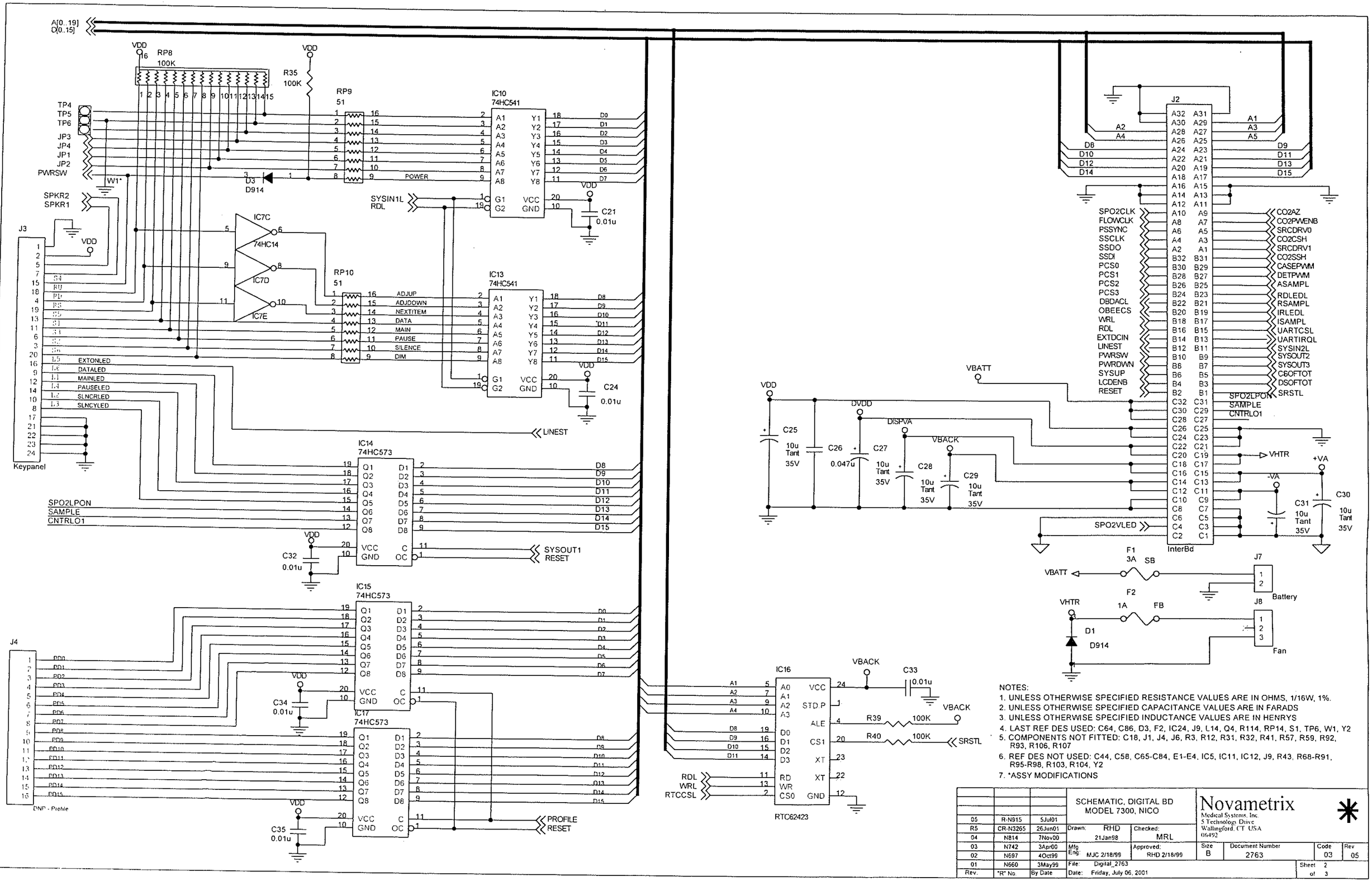
S1
SW-4
CNFG0
CNFG1
CNFG2
JP1

D2 BR1101
R25 499
LED
R29 100
Q2 2N7002

J1
DSL
BERRL
BKPTL
FREEZE
SRSTL
IFETCHL
IPIPEL
MVDD
R30 10K
R33 10K
DNP - Background Mode

D3
D8
D9
CO2PWENB
SYSUP
BOOTWE
CASEPWM
DETPWM
PWRDWN
R19 10K
R20 10K
R21 10K
R22 10K
R23 10K
R24 10K
R26 10K
R27 10K
R28 10K
JP1
JP2
JP3
JP4
R31 DNP
R32 DNP
R93 DNP
R94 10
RESET
R34 1K

			SCHEMATIC, DIGITAL BD MODEL 7300, NICO				
05	R-N915	5Jul01	Drawn: RHD 21Jan98	Checked: MRL	Novametrix Medical Systems, Inc. 5 Technology Drive Wallingford, CT USA 06492		
R5	CR-N3265	26Jun01					
04	N814	7Nov00					
03	N742	3Apr00	Mfg Eng: MJC 2/18/99	Approved: RHD 2/18/99	Size B	Document Number 2763	Code 03 / Rev 05
02	N697	4Oct99					
01	N560	3May99	File: Digital_2763				Sheet 1 of 3
Rev.	"R" No.	By Date	Date: Friday, July 06, 2001				


A[0..19]
C[0..15]
VDD
RP8
100K
R35
100K
TP4
TP5
TP6
JP3
JP4
JP1
JP2
PWRSW
W1*
SPKR2
SPKR1
J3
Keypanel
EXTONLED
DATALED
MAINLED
PAUSELED
SLNCRLED
SLNCYLED
D3
D914
POWER
RP9
51
IC10
74HC541
SYSIN1L
RDL
C21
0.01u
IC7C
74HC14
IC7D
IC7E
RP10
51
ADJUP
ADJDOWN
NEXTITEM
DATA
MAIN
PAUSE
SILENCE
DIM
IC13
74HC541
C24
0.01u
LINEST
IC14
74HC573
SPO2LPON
SAMPLE
CNTRLO1
C32
0.01u
SYSOUT1
RESET
IC15
74HC573
J4
DNP - Profile
C34
0.01u
IC17
74HC573
C35
0.01u
PROFILE
RESET
J2
InterBd
SPO2CLK
FLOWCLK
PSSYNC
SSCLK
SSDO
SSDI
PCS0
PCS1
PCS2
PCS3
DBDACL
OBEECS
WRL
RDL
EXTDCIN
LINEST
PWRSW
PWRDWN
SYSUP
LCDENB
RESET
CO2AZ
CO2PWENB
SRCDRV0
CO2CSH
SRCDRV1
CO2SSH
CASEPWM
DETPWM
ASAMPL
RDLEDL
RSAMPL
IRLEDL
ISAMPL
UARTCSL
UARTIRQL
SYSIN2L
SYSOUT2
SYSOUT3
C6OFTOT
DSOFTOT
SRSTL
SPO2LPON
SAMPLE
CNTRLO1
VHTR
+VA
-VA
C30
10u
Tant
35V
C31
10u
Tant
35V
SPO2VLED
VBATT
DVDD
DISPVA
VBACK
C25
10u
Tant
35V
C26
0.047u
C27
10u
Tant
35V
C28
10u
Tant
35V
C29
10u
Tant
35V
F1
3A SB
F2
1A FB
J7
Battery
J8
Fan
D1
D914
IC16
RTC62423
C33
0.01u
R39
100K
R40
100K
SRSTL
RTCCSL
NOTES:
1. UNLESS OTHERWISE SPECIFIED RESISTANCE VALUES ARE IN OHMS, 1/16W, 1%.
2. UNLESS OTHERWISE SPECIFIED CAPACITANCE VALUES ARE IN FARADS
3. UNLESS OTHERWISE SPECIFIED INDUCTANCE VALUES ARE IN HENRYS
4. LAST REF DES USED: C64, C86, D3, F2, IC24, J9, L14, Q4, R114, RP14, S1, TP6, W1, Y2
5. COMPONENTS NOT FITTED: C18, J1, J4, J6, R3, R12, R31, R32, R41, R57, R59, R92, R93, R106, R107
6. REF DES NOT USED: C44, C58, C65-C84, E1-E4, IC5, IC11, IC12, J9, R43, R68-R91, R95-R98, R103, R104, Y2
7. *ASSY MODIFICATIONS
SCHEMATIC, DIGITAL BD
MODEL 7300, NICO
Novametrix
Medical Systems, Inc.
5 Technology Drive
Wallingford, CT USA
06492
05 R-N915 5Jul01
R5 CR-N3265 26Jun01
04 N814 7Nov00
03 N742 3Apr00
02 N697 4Oct99
01 N660 3May99
Rev. "R" No. By Date
Drawn: RHD 21Jan98
Checked: MRL
Mfg Eng: MJC 2/18/99
Approved: RHD 2/18/99
Size B
Document Number 2763
Code 03
Rev 05
File: Digital_2763
Date: Friday, July 06, 2001
Sheet 2 of 3

A[0..19]
D[0..15]

IC19
SED1353F

IC18
HM628128

IC22
HM628128

IC2
MACH4

IC24*
LM78L05

IC20
TLC5620C

IC21A
TLE2022

IC21B
TLE2022

IC23
MC34119

74HC14
IC7F

RP11a
51 EA

RP11b 51 EA

RP12 51 EA

RP13
51 EA

RP14
51 EA

J5
Display

J6
DNP - Display Contrast

Q3
T2907A

L13
BLM21B102SPT

L12
51R00P

TP1
DGND

TP2

TP3

SCHEMATIC, DIGITAL BD
MODEL 7300, NICO

05	R-N915	5Jul01	Drawn: RHD 21Jan98	Checked: MRL	
R5	CR-N3265	26Jun01			
04	N814	7Nov00			
03	N742	3Apr00	Mfg Eng: MJC 2/18/99	Approved: RHD 2/18/99	
02	N697	4Oct99			
01	N660	3May99	File: Digital_2763		
Rev.	"R" No.	By Date	Date: Friday, July 06, 2001		

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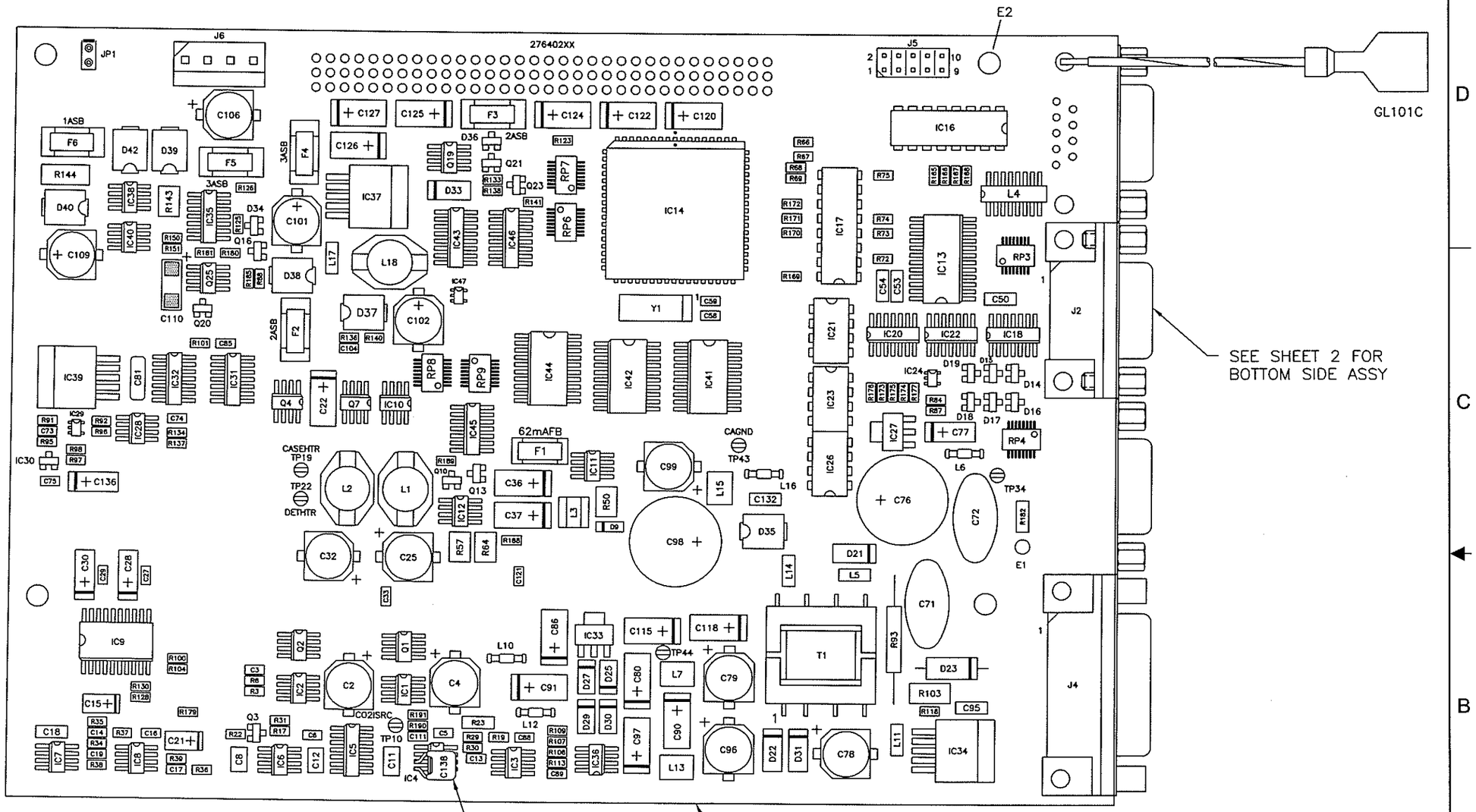
Wallingford, CT USA
06492

Size	Document Number	Code	Rev
B	2763	03	05

Sheet 3 of 3



MOUNT C138 FROM IC4-3 TO IC4-4

16

F1 62mAFB

3/16 APPROX CENTRALLY LOCATE

LOCATE KAPTON TAPE BEFORE MOUNTING F1

FEEDTHRU

32 COVER MOUNTING PAD AND FEEDTHRU

1/32 APPROX

1/8 APPROX

DETAIL A
SCALE: 4/1

NOTES:

1. FOR TEST PROCEDURE SEE A2764-04.
2. COMPONENTS NOT FITTED: C69, C110, C134, JP1, R54, R55, R61, R62, R123, R157, R159, R185

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REV	R NO.	DATE
04	R-N915	5Jul01
R4	CR-N3265	26Jun01
03	N742	29Mar00
02	N697	10Oct99
01	N660	27Apr99

DO NOT SCALE
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES [mm]
TOLERANCES
.XX ±.01 [.254]
.XXX ±.005 [.127]
.XXXX ±.0025 [.064]
FRAC ±1/64
ANG ±1/4°

☐ SOLID MODEL ON FILE

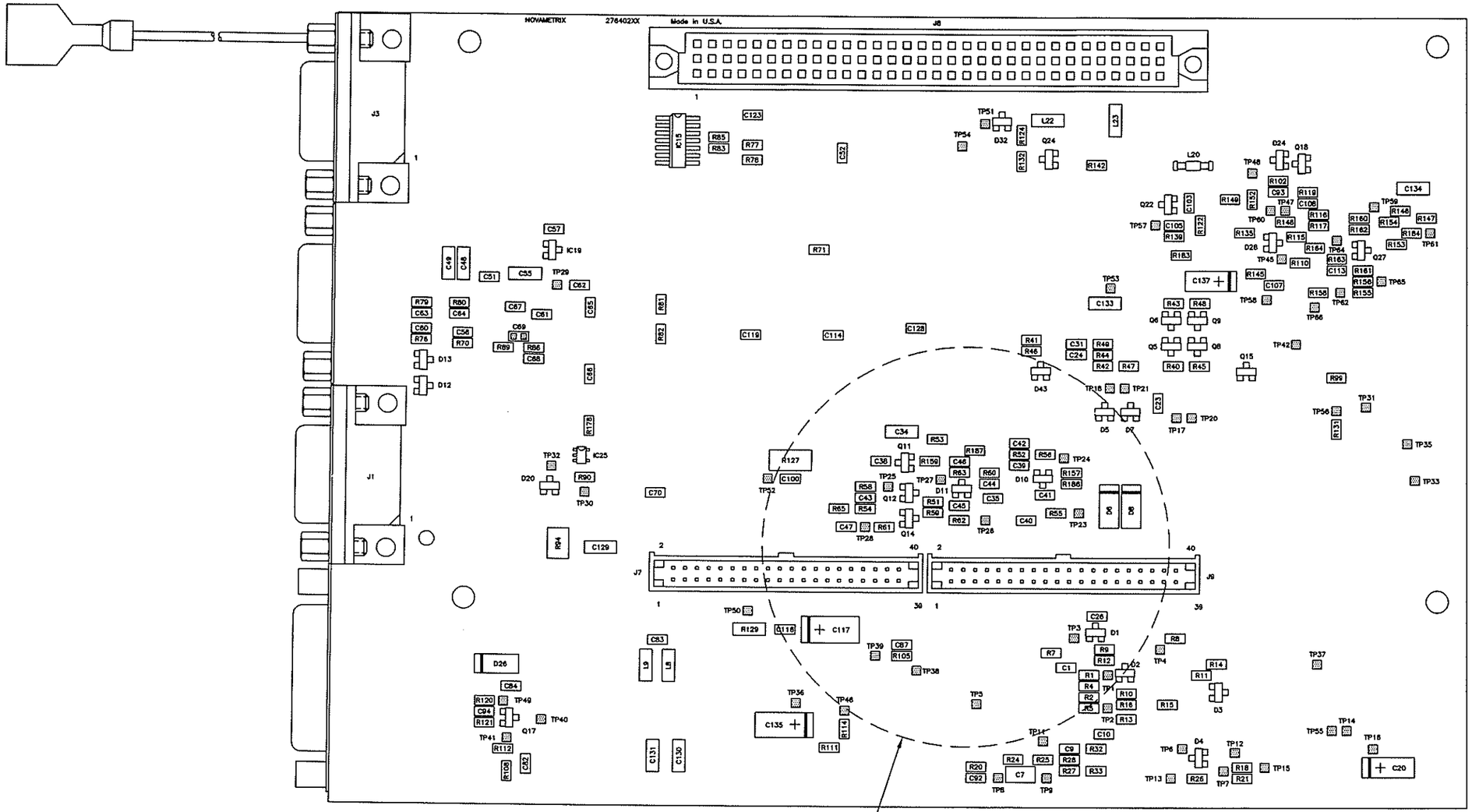
DRAWN	Bob Lancaster	DATE 11Nov98
CHECK	MRL	DATE 17Feb99
MFG ENGR	MJC	DATE 2/17/99
ENGR	RHD	DATE Feb17,99
PROJ ENGR	DRR	DATE 2/17/99
NEXT ASSY: D9226-01		

novametrix
EVERY BEAT, EVERY BREATH, EVERY LIFE

TITLE
POWER BOARD ASSY, MODEL 7300 – NICO

SIZE	DRAWING NO.	CODE	REV
C	2764	01	04

SCALE: 2/1 SHEET 1 OF 3



SEE DETAIL B ON SHEET 3
FOR MODIFICATIONS

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REV	R NO.	DATE
04	R-N915	5Jul01
R4	CR-N3265	26Jun01
03	N742	29Mar00
02	N697	10Oct99
01	N660	27Apr99

DO NOT SCALE
UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES [mm]

TOLERANCES
.XX ±.01 [.254]
.XXX ±.005 [.127]
.XXXX ±.0025 [.064]
FRAC ±1/64
ANG ±1/4°

☐ SOLID MODEL ON FILE

DRAWN	Bob Lancaster	DATE 11Nov98
CHECK	MRL	DATE 17Feb99
MFG ENGR	MJC	DATE 2/17/99
ENGR	RHD	DATE Feb17,99
PROJ ENGR	DRR	DATE 2/17/99
NEXT ASSY: 09226-01		

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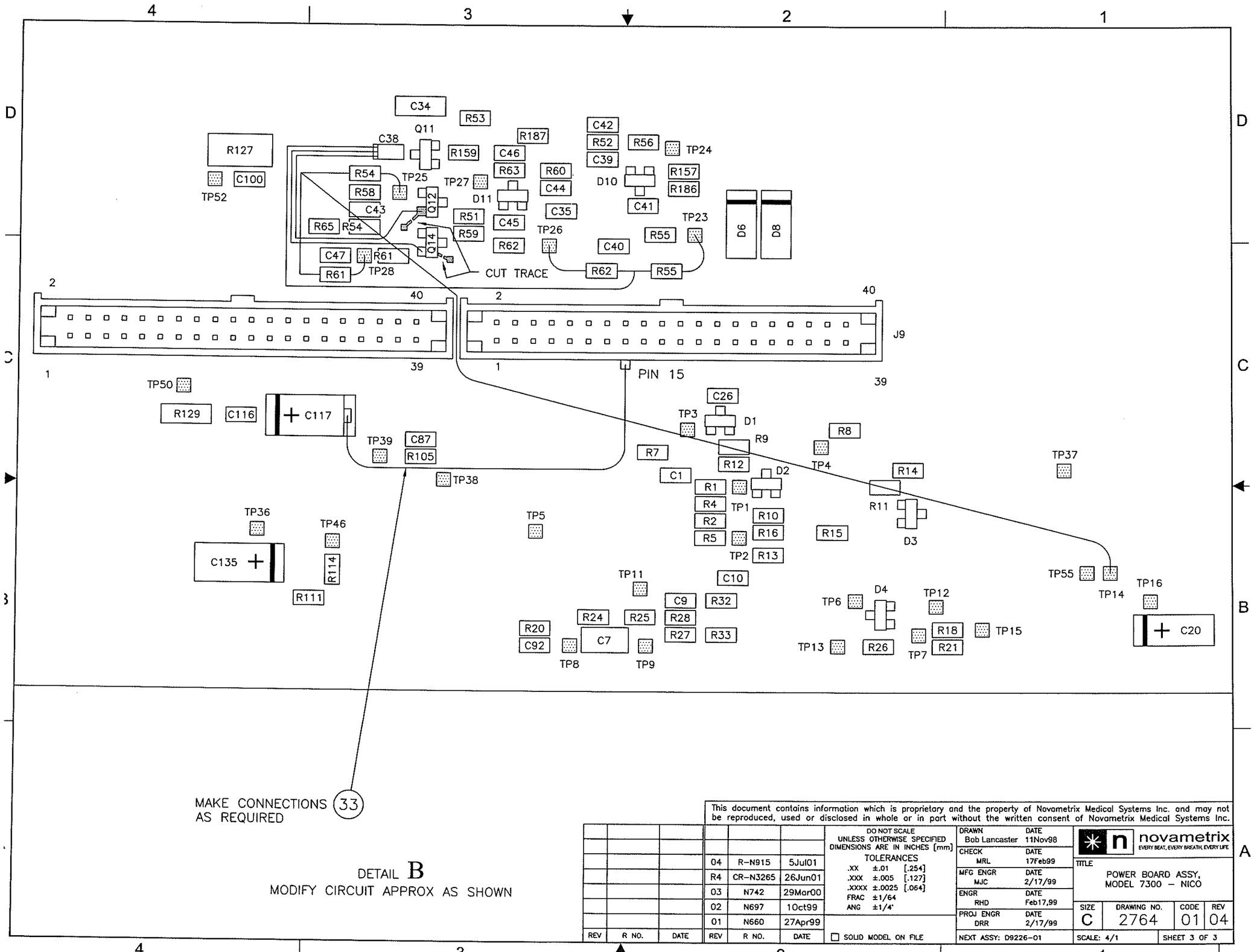
EVERY BEAT, EVERY BREATH, EVERY LIFE

TITLE
POWER BOARD ASSY,
MODEL 7300 - NICO

SIZE	DRAWING NO.	CODE	REV
C	2764	01	04

SCALE: 2/1 SHEET 2 OF 3



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03	N742	29Mar00
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DO NOT SCALE
UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES [mm]
TOLERANCES
.XX ±.01 [.254]
.XXX ±.005 [.127]
.XXXX ±.0025 [.064]
FRAC ±1/64
ANG ±1/4°

☐ SOLID MODEL ON FILE

DRAWN	Bob Lancaster	DATE 11Nov98
CHECK	MRL	DATE 17Feb99
MFG ENGR	MJC	DATE 2/17/99
ENGR	RHD	DATE Feb17,99
PROJ ENGR	DRR	DATE 2/17/99

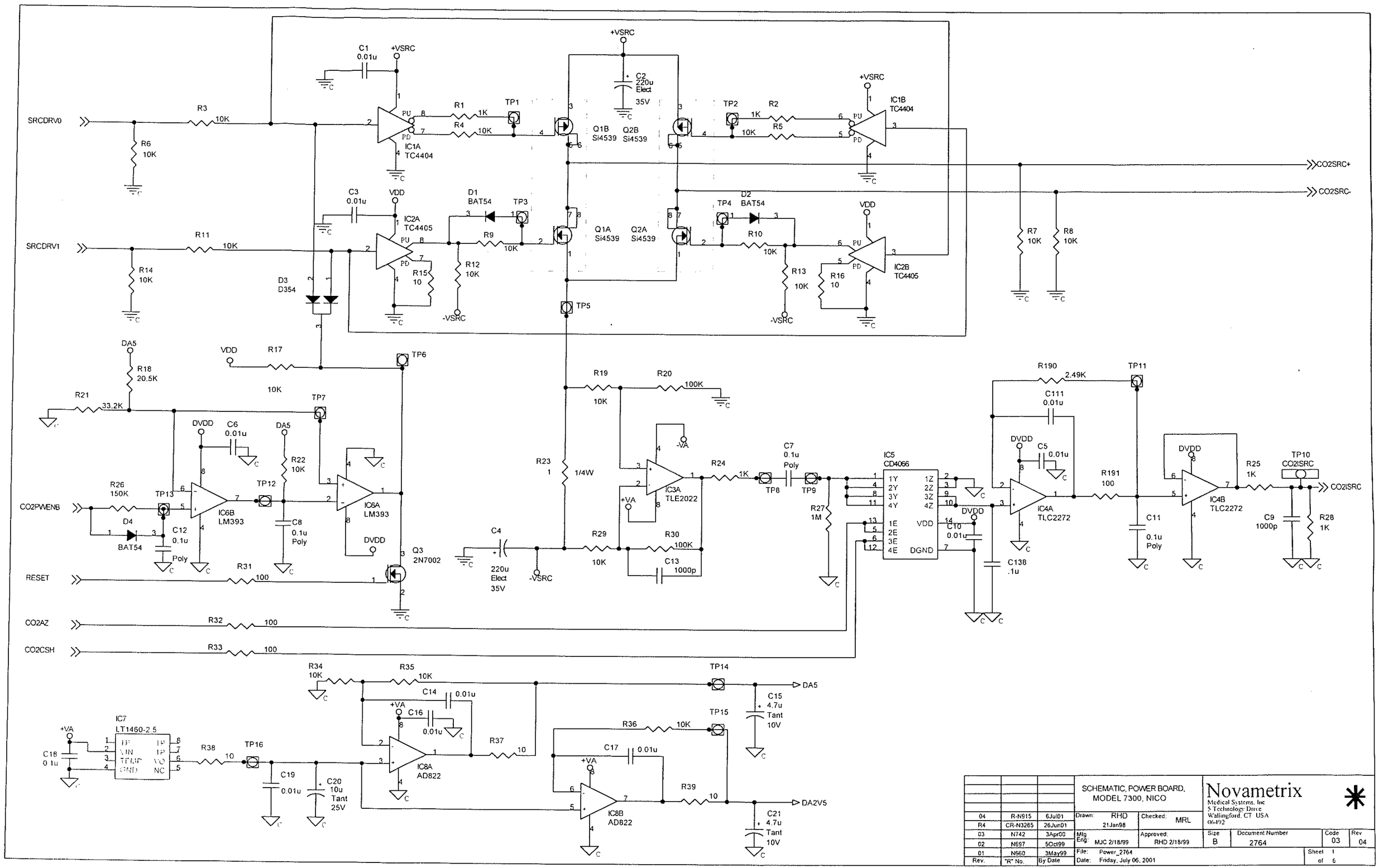
NEXT ASSY: D9226-01

novametrix
EVERY BEAT, EVERY BREATH, EVERY LIFE

TITLE
POWER BOARD ASSY,
MODEL 7300 – NICO

SIZE	DRAWING NO.	CODE	REV
C	2764	01	04

SCALE: 4/1 SHEET 3 OF 3



SCHEMATIC, POWER BOARD, MODEL 7300, NICO

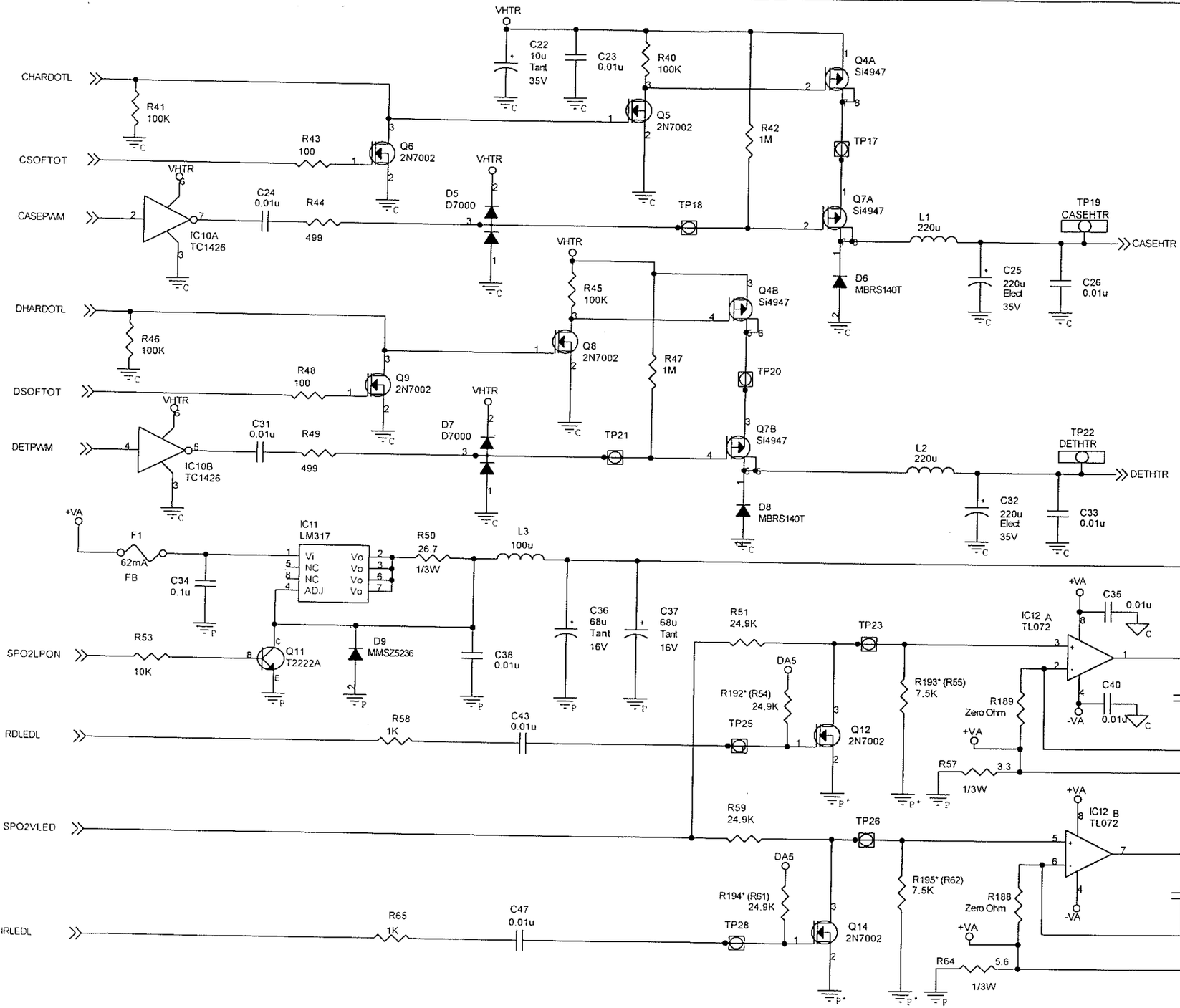
Novametrix
Medical Systems, Inc
5 Technology Drive
Wallingford, CT USA
06492

Rev.	"R" No.	By Date
04	R-N915	6Jul01
R4	CR-N3265	26Jun01
03	N742	3Apr00
02	N697	5Oct99
01	N660	3May99

Drawn: RHD 21Jan98 | Checked: MRL
Mfg Eng: MJC 2/18/99 | Approved: RHD 2/18/99
File: Power_2764
Date: Friday, July 06, 2001

Size	Document Number	Code	Rev
B	2764	03	04

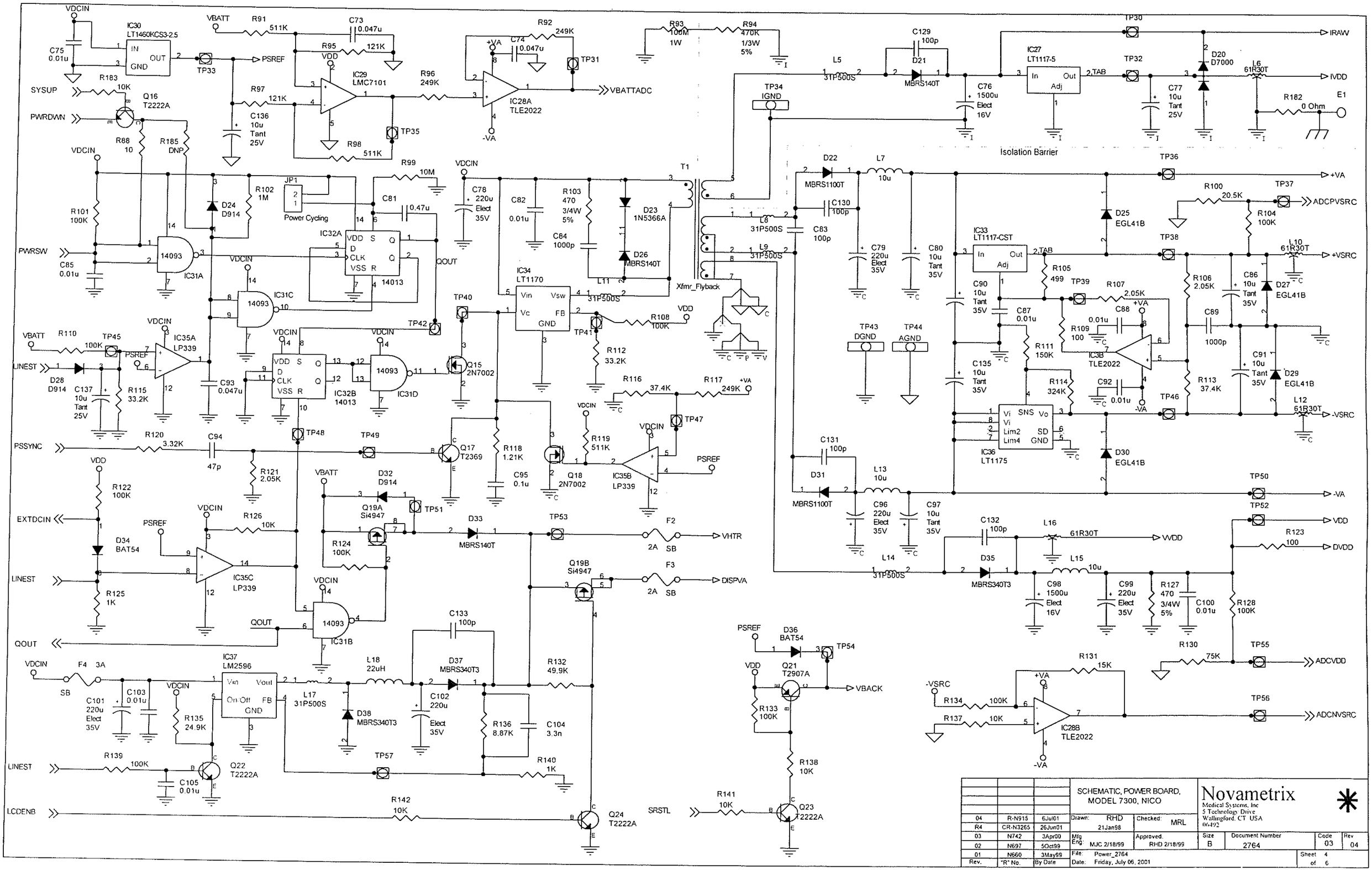
Sheet 1 of 5



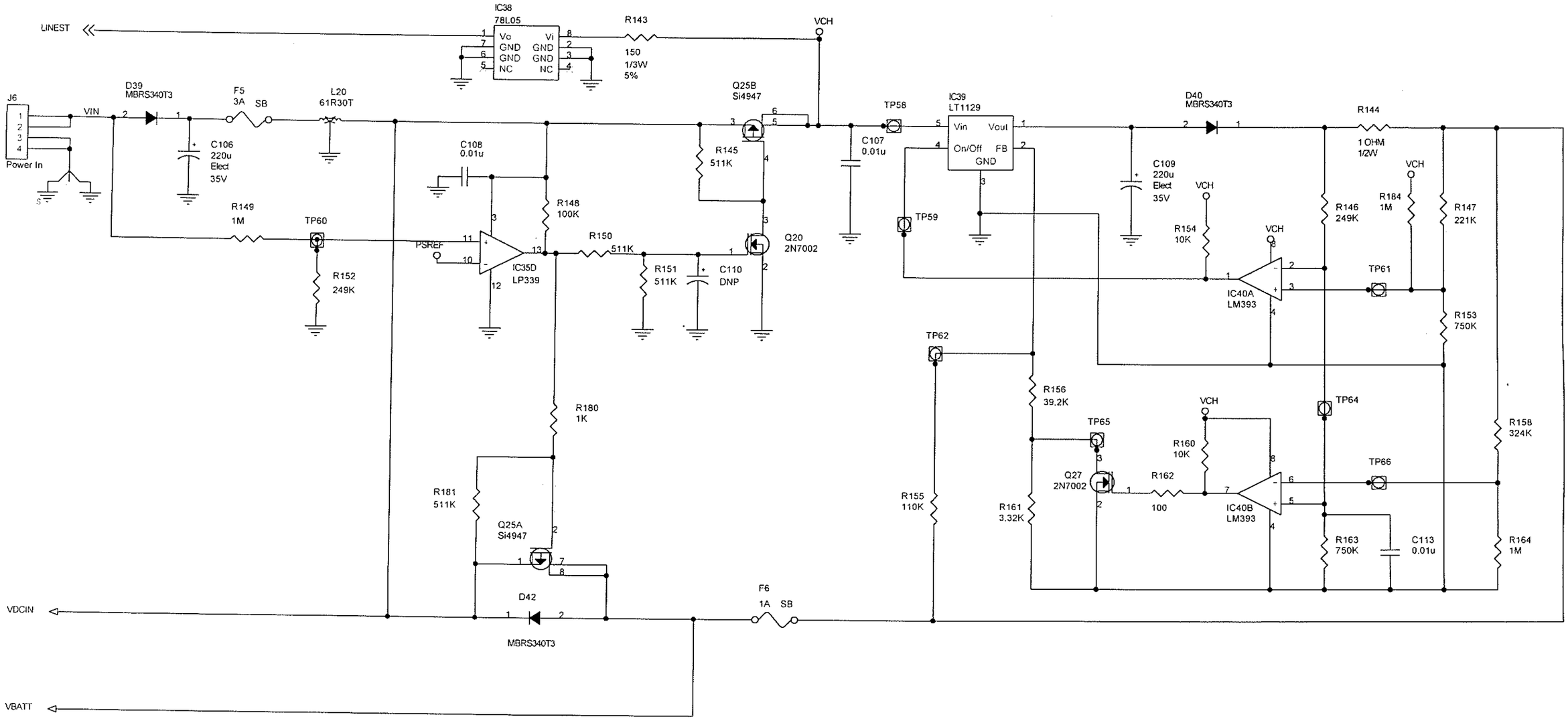
			SCHEMATIC, POWER BOARD, MODEL 7300, NICO		Novametrix Medical Systems, Inc 5 Technology Drive Wallingford, CT USA 06492
04	R-N915	6Jul01	Drawn: RHD 21Jan98	Checked: MRL	
R4	CR-N3265	26Jun01			
03	N742	3Apr00	Mfg Eng: MJC 2/18/99	Approved: RHD 2/18/99	Size B / Document Number 2764 / Code 03 / Rev 04
02	N697	5Oct99			
01	N560	3May99	File: Power_2764		Sheet 2 of 6
Rev.	"R" No.	By Date	Date: Monday, July 09, 2001		

D[8..15]
A[1..5]
IC14
ST16C654
VDD
C52
0.01u
IC15A
IC15B
IC15C
IC15D
SN74HC14D
IC16
ILQ2
IVDD
R66
R67
R68
R69
200
R165
R166
R167
R168
130
IC13
LT1134A
C48
C49
C53
C54
0.1u
C50
C51
C55
0.01u
RP3
1K
L4
F0818-1SR
J1
Serial A
J2
Serial B
J3
Serial C
TxA
RxA
CTSB
TxB
RTSB
RxB
TxC
RxC
UARTCSL
WRL
SRSTL
UARTIRQL
R71
10k
C58
22p
C59
33p
Y1
7.3728MHz
IC17
ILQ2
R72
R73
R74
R75
100
R169
R170
R171
R172
143
C56
0.01u
R70
1K
IC18A
TLC2274
D12
D7000
IC19
LT1460KCS3-2.5
TP29
IREF2V5
C57
0.047u
C60
R76
IC18B
TLC2274
D13
D7000
C61
C62
0.01u
IC20
TLC0834C
C63
R79
C64
R80
IC18C
TLC2274
D14
D7000
D15
D7000
IC18D
TLC2274
RP4
IOSNSE
Analog I/O
J4
J5
Aux Serial
CNTRLIN1
CNTRLO1
SRSTL
R77
R78
100k
AIADCL
AODACL
IC21
HCPL-2631
R81
R82
499
R173
R174
R175
R176
R177
IC22
TLC5620C
C67
0.01u
C68
R84
100K
R86
100
R87
100K
IC24
LMC7101
R89
C69
DNP
D16
D7000
D17
D7000
D18
D7000
D19
D7000
SSCLK
SSDO
IC15E
IC15F
IC23
HCPL-2631
R83
R85
C66
C65
SSDI
CNTRLIN1
IC25
NC7S00
IC26
HCPL-2631
C70
R90
R178
IOSNSE

			SCHEMATIC, POWER BOARD, MODEL 7300, NICO		Novametrix Medical Systems, Inc 5 Technology Drive Wallingford CT USA 06492
04	R-N915	6Jul01	Drawn: RHD 21Jan98	Checked: MRL	
R4	CR-N3265	26Jun01			
03	N742	3Apr00	Mfg Eng: MJC 2/18/99	Approved: RHD 2/18/99	Size B / Document Number 2764 / Code 03 / Rev 04
02	N697	5Oct99			
01	N660	3May99	File: Power_2764		Sheet 3 of 6
Rev.	"R" No.	By Date	Date: Friday, July 06, 2001		



			SCHEMATIC, POWER BOARD, MODEL 7300, NICO		Novametrix Medical Systems, Inc 5 Technology Drive Wallingford, CT USA 06492		
04	R-N915	6Jul01	Drawn: RHD	Checked: MRL			
R4	CR-N3265	26Jun01	21Jan98				
03	N742	3Apr00	Mfg Eng: MJC 2/18/99	Approved: RHD 2/18/99	Size B	Document Number 2764	Code 03 / Rev 04
02	N697	5Oct99					
01	N660	3May99	File: Power_2764		Sheet 4 of 6		
Rev.	"R" No.	By Date	Date: Friday, July 06, 2001				



NOTES:
1. UNLESS OTHERWISE SPECIFIED RESISTANCE VALUES ARE IN OHMS, 1/16W, 1%.
2. UNLESS OTHERWISE SPECIFIED CAPACITANCE VALUES ARE IN FARADS
3. UNLESS OTHERWISE SPECIFIED INDUCTANCE VALUES ARE IN HENRYS
4. LAST USED REF DES: C138, D43, E2, F6, IC47, JP1, J9, L23, Q27, RP9, R195, TP66, T1, Y1
5. COMPONENTS NOT FITTED: C69, C110, C134, JP1, R54, R55, R61, R62, R123, R157, R159, R185
6. REF DES NOT USED: C112, C134, D41, L19, Q26, RP1, RP2, RP5
7. *ASSY MODIFICATIONS

Rev.	"R" No.	By Date
04	R-N915	6Jul01
R4	CR-N3265	26Jun01
03	N742	3Apr00
02	N697	5Oct99
01	N660	3May99

SCHEMATIC, POWER BOARD, MODEL 7300, NICO

Drawn: RHD 21Jan98 | Checked: MRL

Mfg Eng: MJC 2/18/99 | Approved: RHD 2/18/99

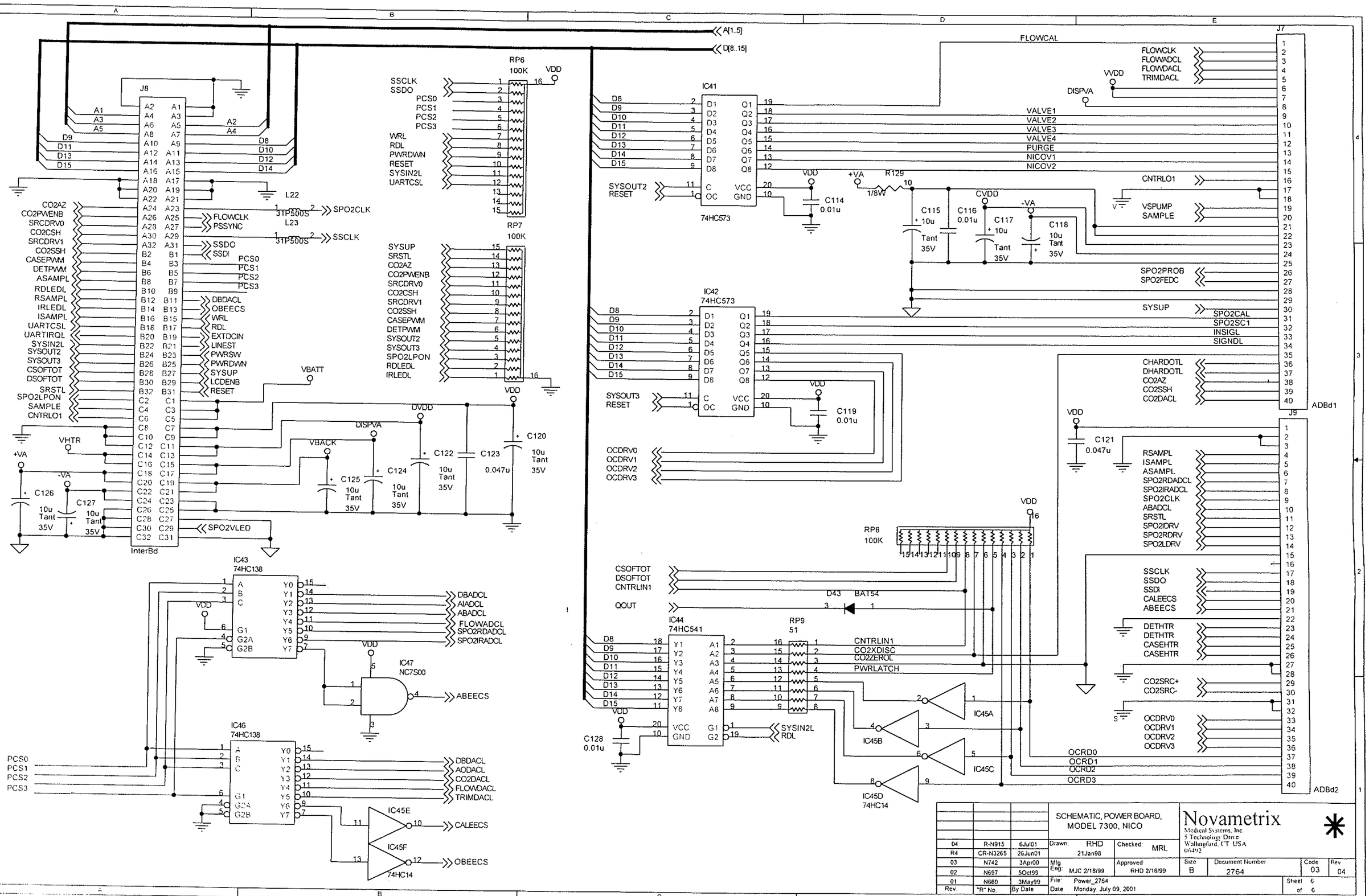
File: Power_2764

Date: Friday, July 06, 2001

Novametrix
Medical Systems, Inc
5 Technology Drive
Wallingford, CT USA
06492

Size	Document Number	Code	Rev
B	2764	03	04

Sheet 5 of 6



			SCHEMATIC, POWER BOARD, MODEL 7300, NICO			Novametrix Medical Systems, Inc. 5 Technology Drive Wallingford, CT USA 06492	
04	R-N915	6Jul01	Drawn: RHD	Checked: MRL			
R4	CR-N3265	26Jun01	21Jan98				
03	N742	3Apr00	Mfg Eng: MJC 2/18/99	Approved RHD 2/18/99	Size B	Document Number 2764	Code 03 / Rev 04
02	N697	5Oct99					
01	N660	3May99	File: Power_2764				Sheet 6 of 6
Rev.	"R" No.	By Date	Date Monday, July 09, 2001				

REV	CO NO.	REVISION DESCRIPTION	DFTR	CHKR	RE	DATE
02	R-N697	SEE REVISION NOTICE	RG	MRL	JT	14Oct99
03	R-N742	SEE REVISION NOTICE	RG	MRL	DRR	2May00
04	R-N766	SEE REVISION NOTICE	BL	MRL	DRR	20Jul00
05	R-N824	SEE REVISION NOTICE	RG	BL	EPW	5Feb2001
06	R-N899	SEE REVISION NOTICE	BL	MRL	EPW	1Jun01
07	R-N1013	SEE REVISION NOTICE	BL	MRL	EPW	23Apr02
08	CO_N0041	ADD 9974-32 TO BOM, UPDATE MISC CAPACITORS	RG	~	EPW	7Jan03
09	CO_N0223	ADD NOTE 4, DELETE 9974-32 FROM FIELD OF DWG	BL	RG	SAB	13May03
10	CO_N0390	ADD 153012, 180067 TO BOM & UPDATE DRAWING	RG	BL	CLW	7/14/03

ORIGINAL

(32) APPLY 4 SMALL DROPS OF EPOXY TO VR2 AND BOARD APPROX AS SHOWN

SEE DETAIL H

SEE SHEET 2 FOR BOTTOM ASSY
SEE SHEET 3 FOR PNEUMATIC ASSEMBLY-SCHEMATIC

CUT TRACE

V6 SHOWN REMOVED FOR CLARITY

(15)

276502XX

CONNECT C194 FROM IC33-12 TO IC33-13

CONNECT C195 FROM IC37-12 TO IC37-13

(26) SECURE SPO2 CONNECTOR BRACKET ASSY TO BD

(27) SECURE FLOW CONNECTOR TO BOARD

PRESS SEAL INTO FLOW CONNECTOR AS SHOWN (17)

IC39, IC41, IC42, AND IC43 ARE LOCATED BENEATH FLOW CONNECTOR

NOTES:

1. FOR TEST PROCEDURE SEE A2765-04.
2. THE FOLLOWING COMPONENTS ARE NOT FITTED: C90, D17, IC17, IC18, IC24, IC47, J7, L13, R14, R80, R96, R200, R236, R240, R241, R242
3. FOR EPOXY MIXING ASSY PROCEDURE SEE A9779-33.
4. PLACE THE 9974-32 LABEL ON PC BOARD. THE LOCATION OF THE LABEL IS NOT CRITICAL. LABEL MAY BE PLACED WHERE THERE IS AVAILABLE SPACE. LABEL MAY BE TRIMMED TO FIT ON BOARD. THE BARCODE MAY BE TRIMMED, HOWEVER THE HUMAN READABLE NUMBER ON THE LABEL MAY NOT BE TRIMMED.

SEE SEPARATE BOM

MAKE SURE TUBING ON THIS SIDE OF Y FITTING IS ON TOP OF VR4

DETAIL H

2 PL (18)

SECURE TRANSDUCER SUPPORTS FOR IC29 & IC32. 4 PL (27)

ENSURE THAT TRANSDUCER BD IS SECURED TO ANALOG BOARD WITH FOAM TAPE (29)

DO NOT SCALE DRAWING
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES [mm]
TOLERANCES
.XX ±.01 [.254]
.XXX ±.005 [.127]
.XXXX ±.0025 [.064]
ANG ±1°

THIRD ANGLE PROJECTION

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DRAFTER BL	DATE 23Nov98
CHECKER MJC	DATE 2/18/99
RE DRR	DATE 2/18/99

RESPIRONICS®
RESPIRONICS NOVAMETRIX, INC.
HOSPITAL DIVISION

TITLE: ANALOG BOARD ASSY, MODEL 7300 - NICO

SIZE	PART NUMBER	REV
B	2765-01	10

SCALE: 1/1 SHEET 1 OF 3

ORIGINAL

CONNECT FROM IC18-8 TO IC18-4 AND COVER WITH TUBING

30 31

DISREGARD TP5 MARKING

V6-1

V4-1

605103
CONNECT FROM V6-1
TO V4-1

CONNECT CAPACITOR
FROM IC-1 TO IC-2

CONNECT CAPACITOR
FROM IC-3 TO IC-8

DETAIL I

SEE DETAIL I

SEE DETAIL I

J1 CONNECTOR REMOVED
IN THIS VIEW FOR CLARITY

CUT CONDUCTOR OF
J1-31 TO FEED THRU
APPROX AS SHOWN

FB1 SHOWN REMOVED FOR
CLARITY. MOUNT ACROSS
BREAK APPROX AS SHOWN

SCRAPE FEED THRU
AND RUN

SEE SEPARATE
BOM

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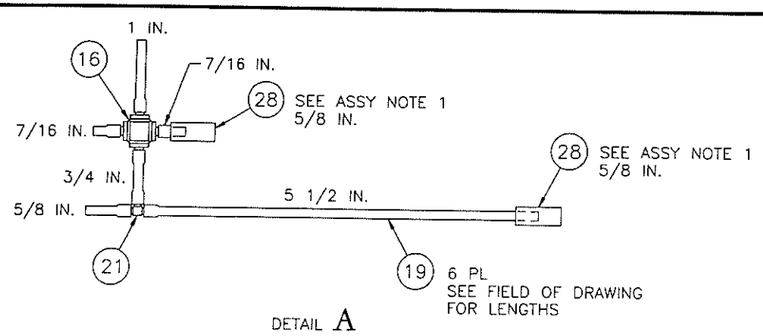
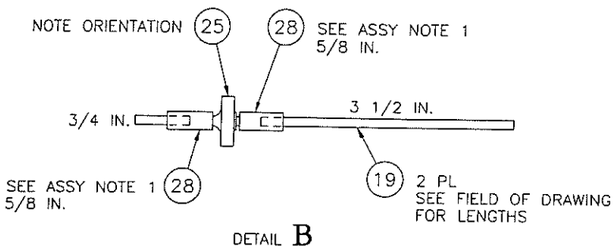
TITLE
ANALOG BOARD ASSY,
MODEL 7300 -- NICO

SIZE	PART NUMBER	REV
B	2765-01	10

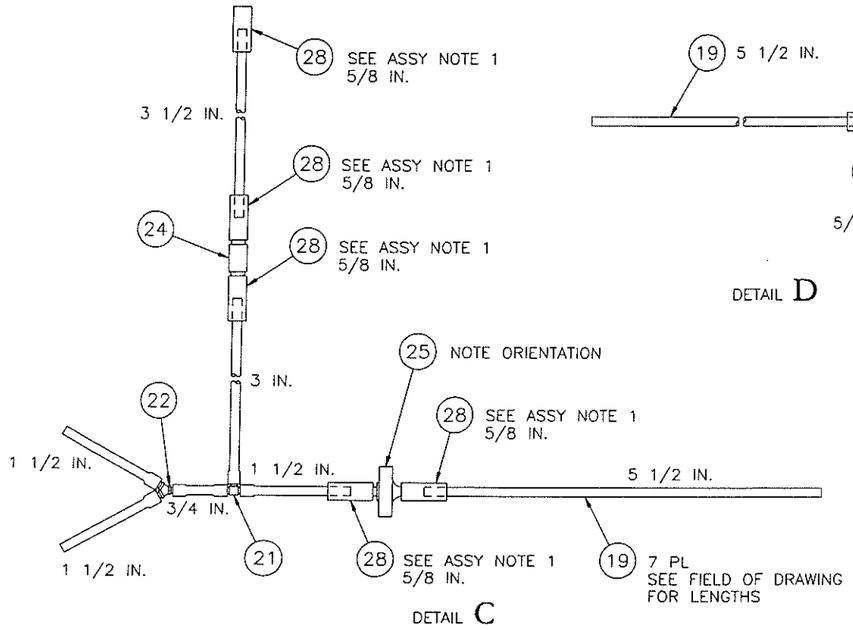
SCALE: NONE | SHEET 2 OF 3



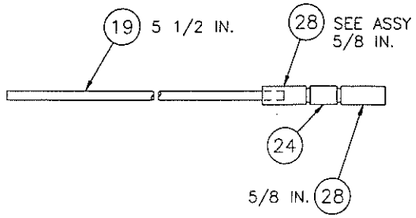
DETAIL A



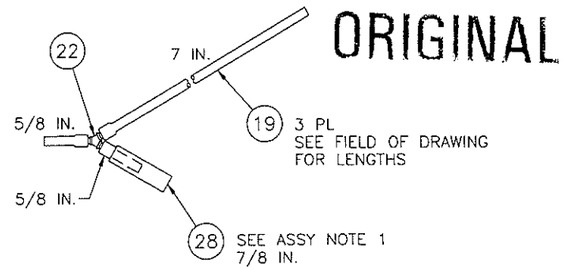
DETAIL B


28 SEE ASSY NOTE 1 5/8 IN.
3 1/2 IN.
28 SEE ASSY NOTE 1 5/8 IN.
24
28 SEE ASSY NOTE 1 5/8 IN.
3 IN.
25 NOTE ORIENTATION
22
28 SEE ASSY NOTE 1 5/8 IN.
1 1/2 IN.
1 1/2 IN.
5 1/2 IN.
3/4 IN.
1 1/2 IN.
21
28 SEE ASSY NOTE 1 5/8 IN.
19 7 PL SEE FIELD OF DRAWING FOR LENGTHS

DETAIL C

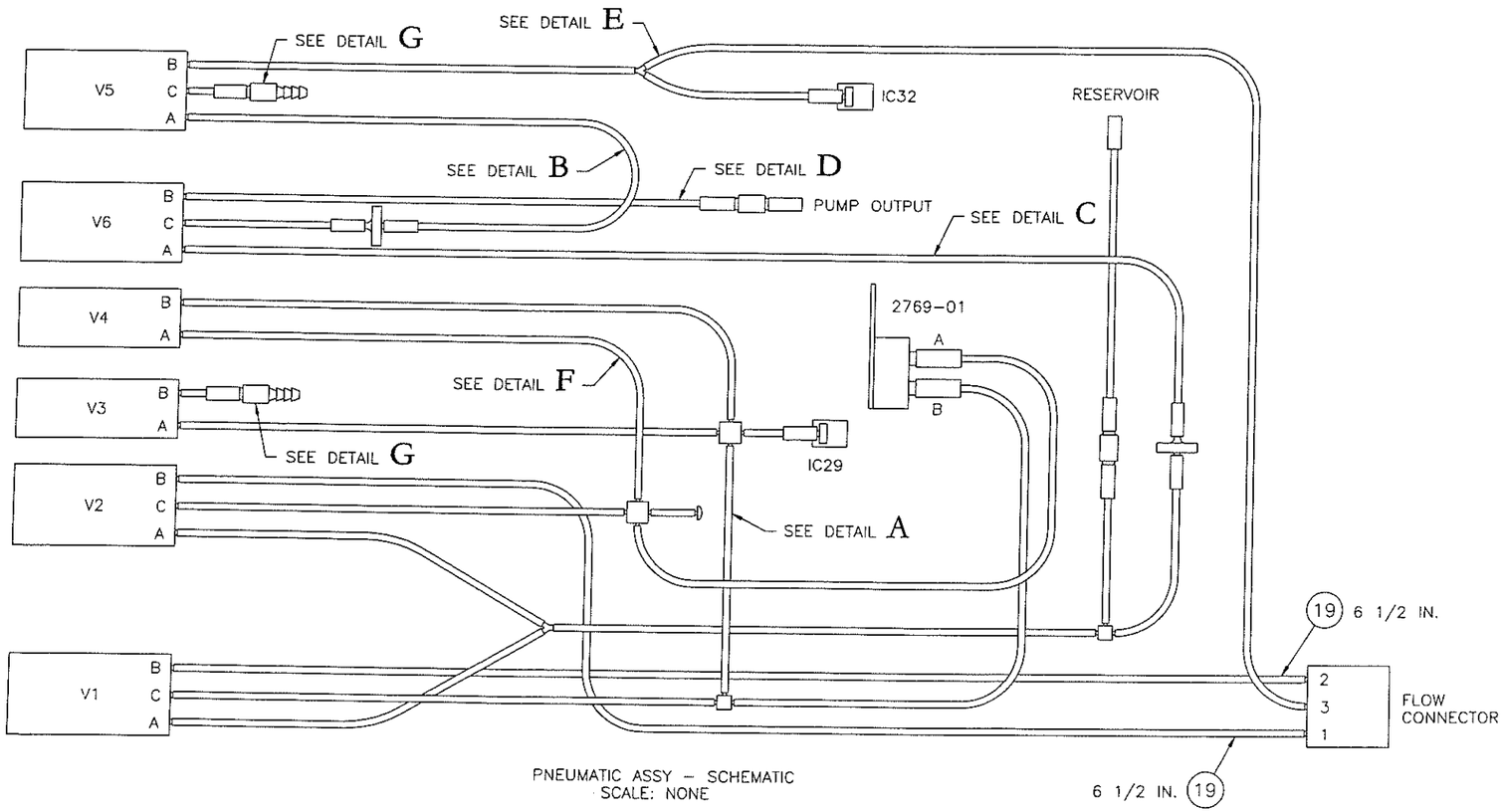


DETAIL D

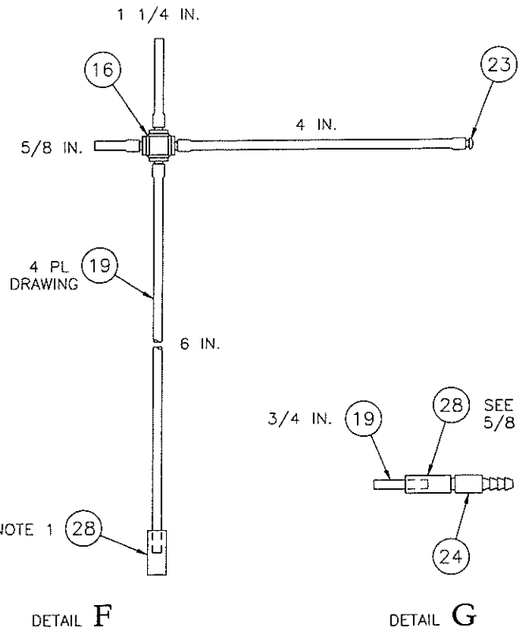


DETAIL E

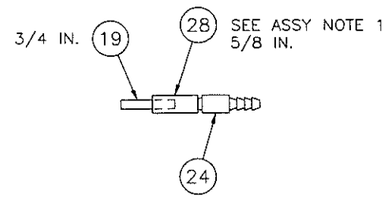
ORIGINAL



PNEUMATIC ASSY – SCHEMATIC
SCALE: NONE



DETAIL F



DETAIL G

SEE SEPARATE BOM

ASSY NOTES:

1. DIP END OF TUBING, ITEM 19, IN 50/50 MIX OF THF/CYCLOHEXANONE, ITEM 20, FOR ONE SECOND. BLOT END OF TUBING ON ABSORBENT TOWEL TO DRAW SOLVENT OUT OF TUBING BORE. INSERT INTO THE LARGER BORE TUBING, ITEM 28, APPROX HALF WAY. ALLOW TO DRY 10 MINUTES.

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RESPIRONICS NOVAMETRIX, INC.
HOSPITAL DIVISION

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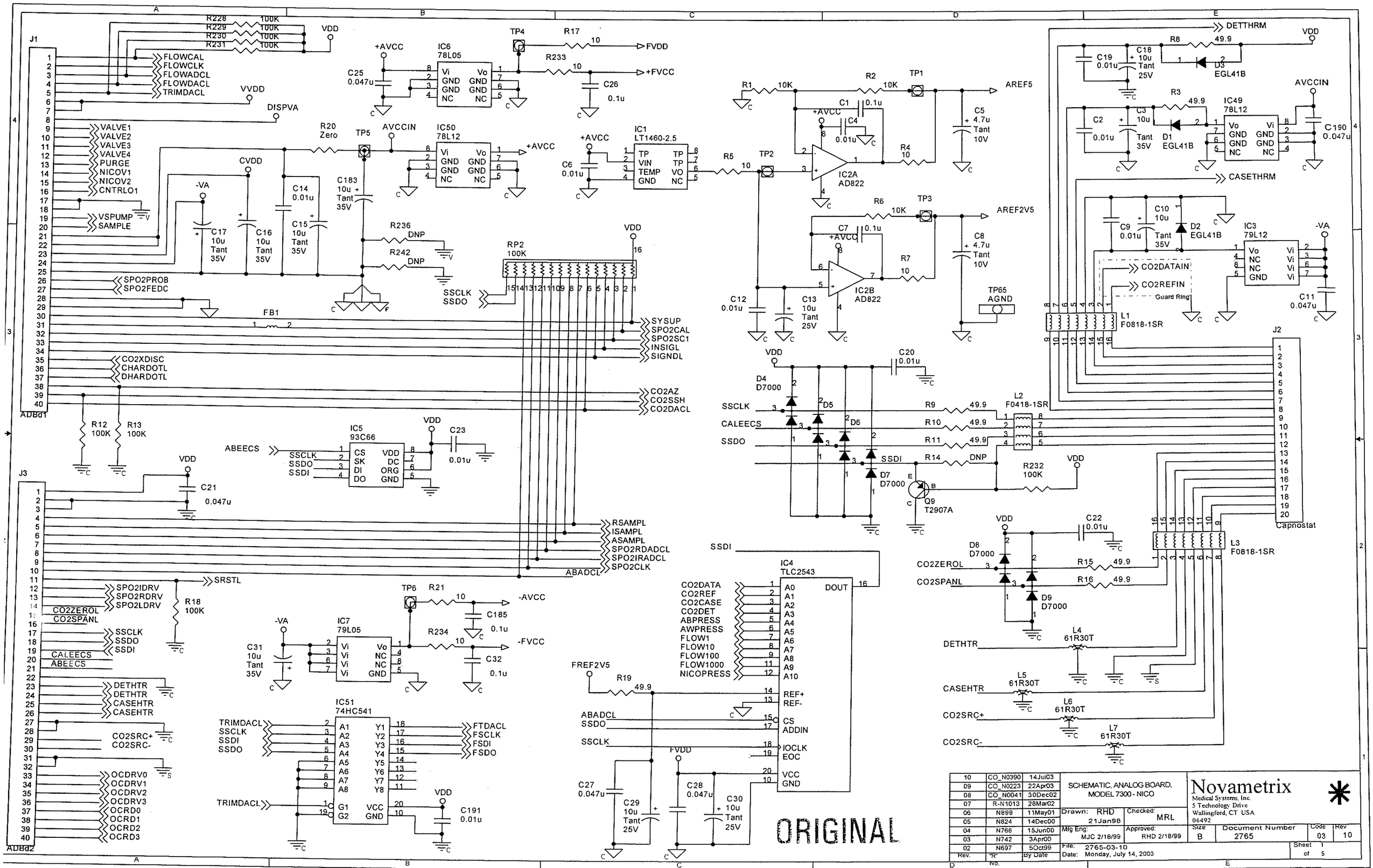
TITLE: ANALOG BOARD ASSY, MODEL 7300 – NICO

SIZE	PART NUMBER	REV
B	2765-01	10

SCALE: 1/1 | SHEET 3 OF 3



Rev.	No.	By Date
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09	CO_N0223	22Apr03
08	CO_N0041	30Dec02
07	R-N1013	28Mar02
06	N899	11May01
05	N824	14Dec00
04	N766	15Jun00
03	N742	3Apr00
02	N697	5Oct99

SCHEMATIC, ANALOG BOARD, MODEL 7300 - NICO

Drawn: RHD 21Jan98 | Checked: MRL

Mfg Eng: MJC 2/18/99 | Approved: RHD 2/18/99

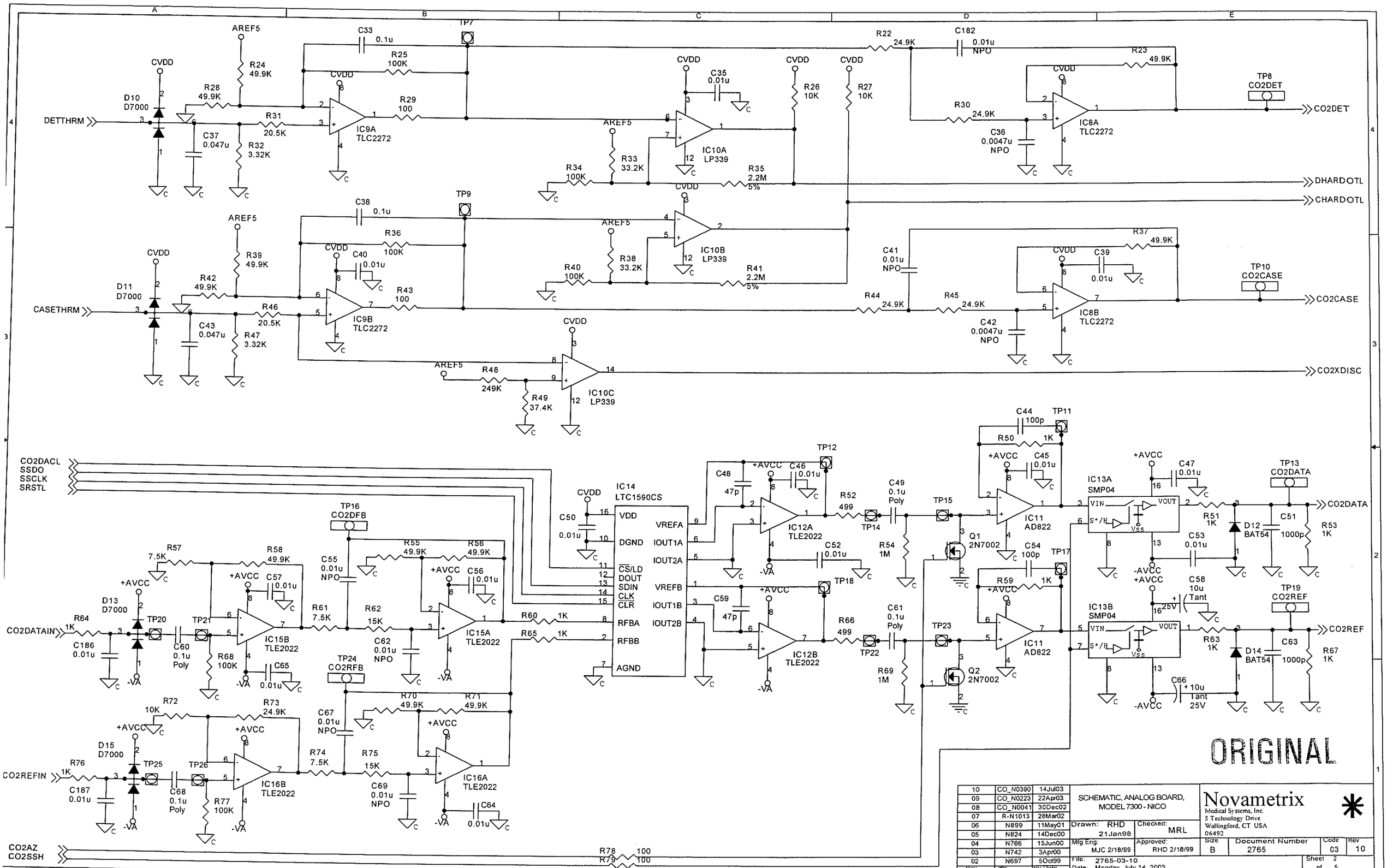
File: 2765-03-10

Date: Monday, July 14, 2003

Novametrix
Medical Systems, Inc.
5 Technology Drive
Wallingford, CT USA
06492

Size	Document Number	Code	Rev
B	2765	03	10

Sheet 1 of 5



ORIGINAL

Rev.	By	Date	Description
10	CO_N0390	14Jul03	
09	CO_N0223	22Apr03	
08	CO_N0041	30Dec02	
07	R-N1013	28Mar02	
06	N899	11May01	
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SCHEMATIC, ANALOG BOARD, MODEL 7300 - NICO

Drawn: RHD 21Jan98 | Checked: MRL

Mfg Eng: MJC 2/18/99 | Approved: RHD 2/18/99

File: 2765-03-10

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Novametrix
Medical Systems, Inc.
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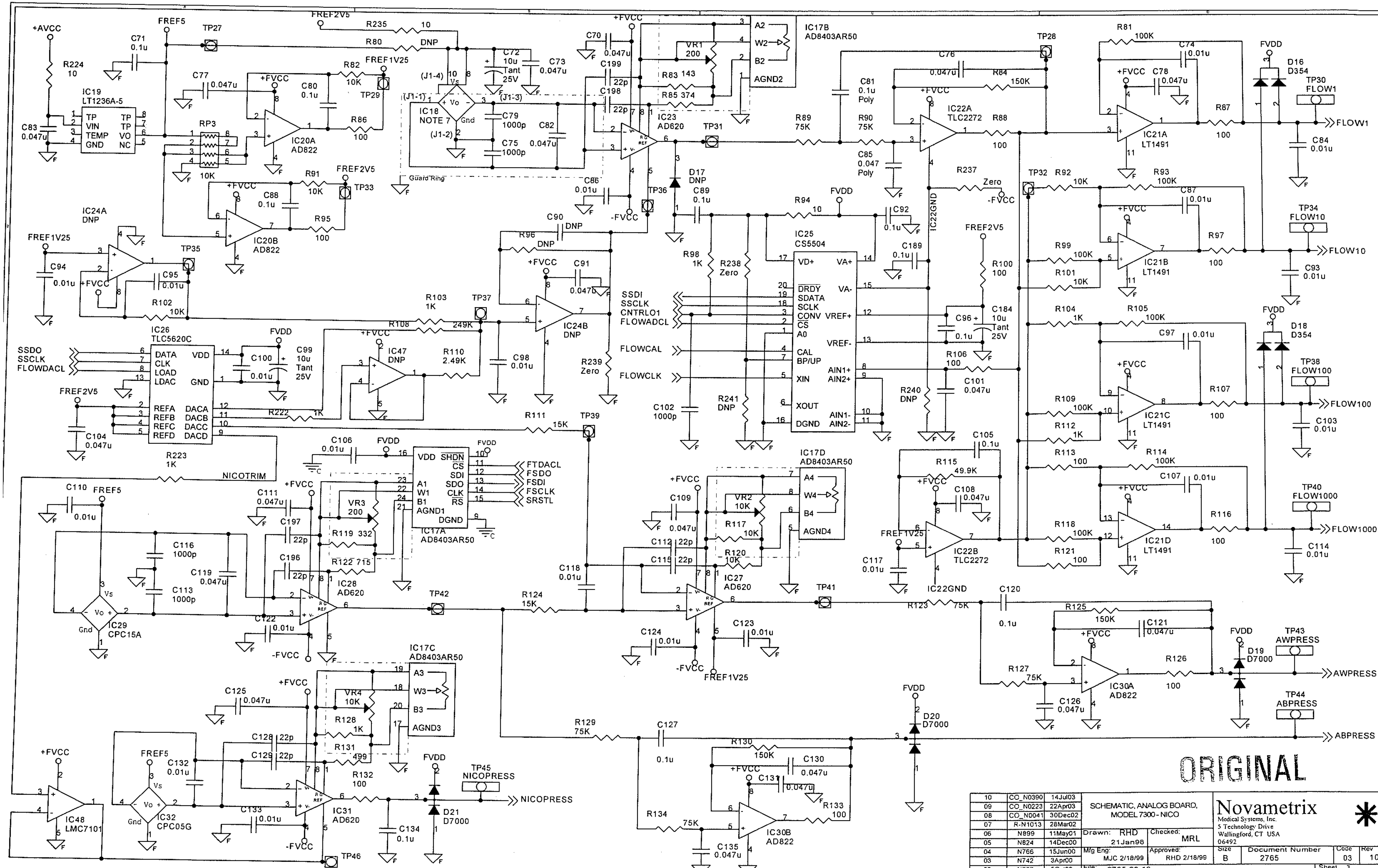
Wallingford, CT USA
06492

Size	Document Number	Code	Rev
B	2765	03	10

Sheet 2 of 5



+AVCC
FREF5
FREF2V5
FREF1V25
+FVCC
-FVCC
FVDD
IC19 LT1236A-5
IC20A AD822
IC20B AD822
IC18 NOTE 7
Guard Ring
IC23 AD620
IC17B AD8403AR50
IC22A TLC2272
IC21A LT1491
IC21B LT1491
IC21C LT1491
IC21D LT1491
IC24A DNP
IC24B DNP
IC25 CS5504
IC26 TLC5620C
IC47 DNP
IC17A AD8403AR50
IC17C AD8403AR50
IC17D AD8403AR50
IC22B TLC2272
IC22GND
IC28 AD620
IC27 AD620
IC29 CPC15A
IC30A AD822
IC30B AD822
IC31 AD620
IC32 CPC05G
IC48 LMC7101
D16 D354
D17 DNP
D18 D354
D19 D7000
D20 D7000
D21 D7000
SSDO
SSCLK
FLOWDACL
SSDI
CNTRLO1
FLOWCAL
FLOWCLK
NICOTRIM
FTDACL
FSDO
FSDI
FSCLK
SRSTL
TP30 FLOW1
TP34 FLOW10
TP38 FLOW100
TP40 FLOW1000
TP43 AWPRESS
TP44 ABPRESS
TP45 NICOPRESS
FLOW1
FLOW10
FLOW100
FLOW1000
AWPRESS
ABPRESS
NICOPRESS

ORIGINAL

Rev.	"R" No.	By Date
10	CO_N0390	14Jul03
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03	N742	3Apr00
02	N697	5Oct99

SCHEMATIC, ANALOG BOARD, MODEL 7300 - NICO

Drawn: RHD 21Jan98 — Checked: MRL

Mfg Eng: MJC 2/18/99 — Approved: RHD 2/18/99

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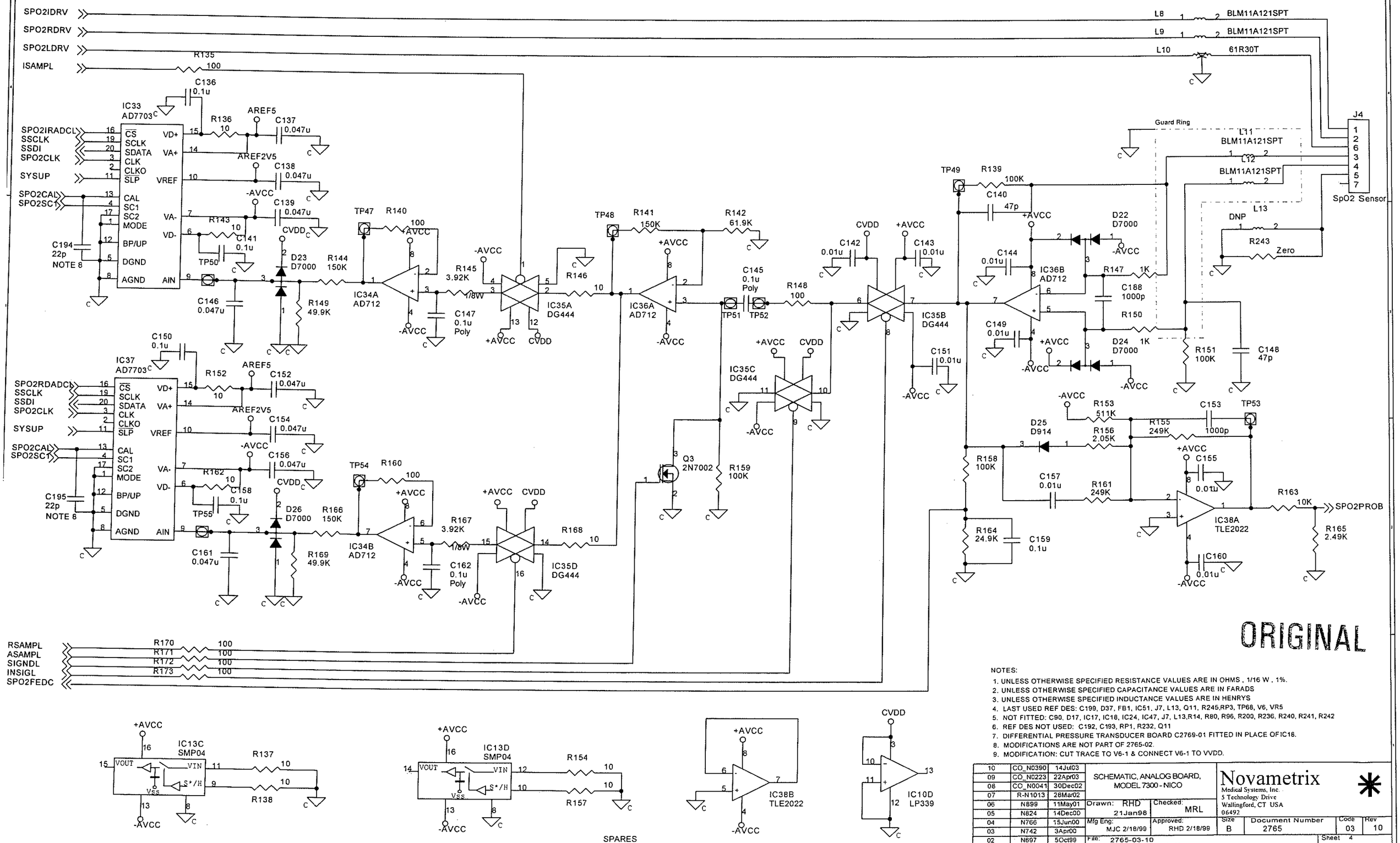
Size: B — Document Number: 2765 — Code: 03 — Rev: 10

File: 2765-03-10 — Date: Monday, July 14, 2003 — Sheet 3 of 5



ORIGINAL

NOTES:

1. UNLESS OTHERWISE SPECIFIED RESISTANCE VALUES ARE IN OHMS , 1/16 W , 1%.
2. UNLESS OTHERWISE SPECIFIED CAPACITANCE VALUES ARE IN FARADS
3. UNLESS OTHERWISE SPECIFIED INDUCTANCE VALUES ARE IN HENRYS
4. LAST USED REF DES: C199, D37, FB1, IC51, J7, L13, Q11, R245,RP3, TP68, V6, VR5
5. NOT FITTED: C90, D17, IC17, IC18, IC24, IC47, J7, L13,R14, R80, R96, R200, R236, R240, R241, R242
6. REF DES NOT USED: C192, C193, RP1, R232, Q11
7. DIFFERENTIAL PRESSURE TRANSDUCER BOARD C2769-01 FITTED IN PLACE OF IC18.
8. MODIFICATIONS ARE NOT PART OF 2765-02.
9. MODIFICATION: CUT TRACE TO V6-1 & CONNECT V6-1 TO VVDD.

Rev.	"R" No.	By	Date
10	CO_N0390	14Jul03	
09	CO_N0223	22Apr03	
08	CO_N0041	30Dec02	
07	R-N1013	28Mar02	
06	N899	11May01	
05	N824	14Dec00	
04	N766	15Jun00	
03	N742	3Apr00	
02	N697	5Oct99	

SCHEMATIC, ANALOG BOARD, MODEL 7300 - NICO

Drawn: RHD 21Jan98 | Checked: MRL

Mfg Eng: MJC 2/18/99 | Approved: RHD 2/18/99

File: 2765-03-10

Date: Monday, July 14, 2003

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Wallingford, CT USA
06492

Size	Document Number	Code	Rev
B	2765	03	10

Sheet 4 of 5

VVDD
C164 220u Elect 35V
V1 LFAA0509415H
D27 D7000
3-Way
VALVE1
R179 1M
Q4A Si9945
R182 100K
C165 0.01u
V2 LFAA0509415H
D28 D7000
3-Way
VALVE2
R185 1M
Q4B Si9945
R186 100K
C166 0.01u
VVDD
C167 220u Elect 35V
V3 LFAA0509512H
D29 D7000
2-Way
VALVE3
R193 1M
Q5A Si9945
R196 100K
C168 0.01u
V4 LFAA0509512H
D30 D7000
2-Way
VALVE4
R198 1M
Q5B Si9945
R199 100K
C169 0.01u
R245 10K
NICOV1
VVDD
R244 100K
Q10 T2222A
C24 0.047u
Q7B Si4539
R205 10K
TP67
NICOV1
V5 LFAA0509512H
VVDD
R225 49.9K
R226 100K
C170 220u Elect 35V
D31 D7000
2-Way
VVDD
R227 49.9K
TP68
Q6A Si9945
IC44B LM393
C34 0.047u
VVDD SEE NOTE 9
V6 LFAA0509512H
D34 D7000
2-Way
R206 100K
D37 BAT54
C172 10u Tant 25V
NICOV2
R208 1M
Q6B Si9945
R209 100K
C174 0.01u
J7
Sampling Pump DNP
DISPVA
C176 0.047u
IC45 LP2951AC
VIN
FDBK
SHTDN
TAP
SENS
VOUT
ERR
GND
R214 24.9K
R213 24.9K
C179 0.01u
C180 220u Elect 35V
D36 D7000
SAMPLE
R218 10K
Q8 T2222A
R221 100K
VR5 50K
R220 10K
R219 1 1/4W
R210 1.21K
R211 150K
TP64
VVDD C178 0.01u
IC46B TLC2272
R216 75K
R217 75K
C177 0.1u
C175 0.047u
R212 150K
IC46A TLC2272
C181 0.047u
R215 100
VSPUMP
TP63 VSPUMP
TP66 VGND
ORIGINAL

VDD
R177 100K
OCDRV0
R178 511 1/8W
IC39 ERT3281
TP56
J5 Flow Conn
Dummy
R174 249K
R175 100K
C163 0.047u
R176 1K
IC40A LP339
OCRD0
R183 100K
OCDRV1
R184 511 1/8W
IC41 ERT3281
TP57
R180 100K
R181 1K
IC40B LP339
OCRD1
R189 100K
OCDRV2
R190 511 1/8W
IC42 ERT3281
TP58
R187 100K
R188 1K
IC40C LP339
OCRD2
R194 100K
OCDRV3
R195 511 1/8W
IC43 ERT3281
TP60
TP59
R191 100K
R192 1K
IC40D LP339
OCRD3
R197 150K
PURGE
R202 100K
R201 10K
TP61
R203 49.9K
R204 100K
R207 49.9K
TP62
IC44A LM393
D35 BAT54
C173 10u Tant 25V
DISPVA
R200 DNP
D33 D7000
Q7A Si4539
C171 220u Elect 35V
D32 BAT54
J6
Purge Pump

Rev.	"R" No.	By	Date	
10	CO_N0390		14Jul03	SCHEMATIC, ANALOG BOARD, MODEL 7300 - NICO
09	CO_N0223		22Apr03	
08	CO_N0041		30Dec02	
07	R-N1013		28Mar02	
06	N899		11May01	Drawn: RHD 21Jan98
05	N824		14Dec00	Checked: MRL
04	N766		15Jun00	Mfg Eng: MJC 2/18/99
03	N742		3Apr00	Approved: RHD 2/18/99
02	N697		5Oct99	File: 2765-03-10
				Date: Monday, July 14, 2003

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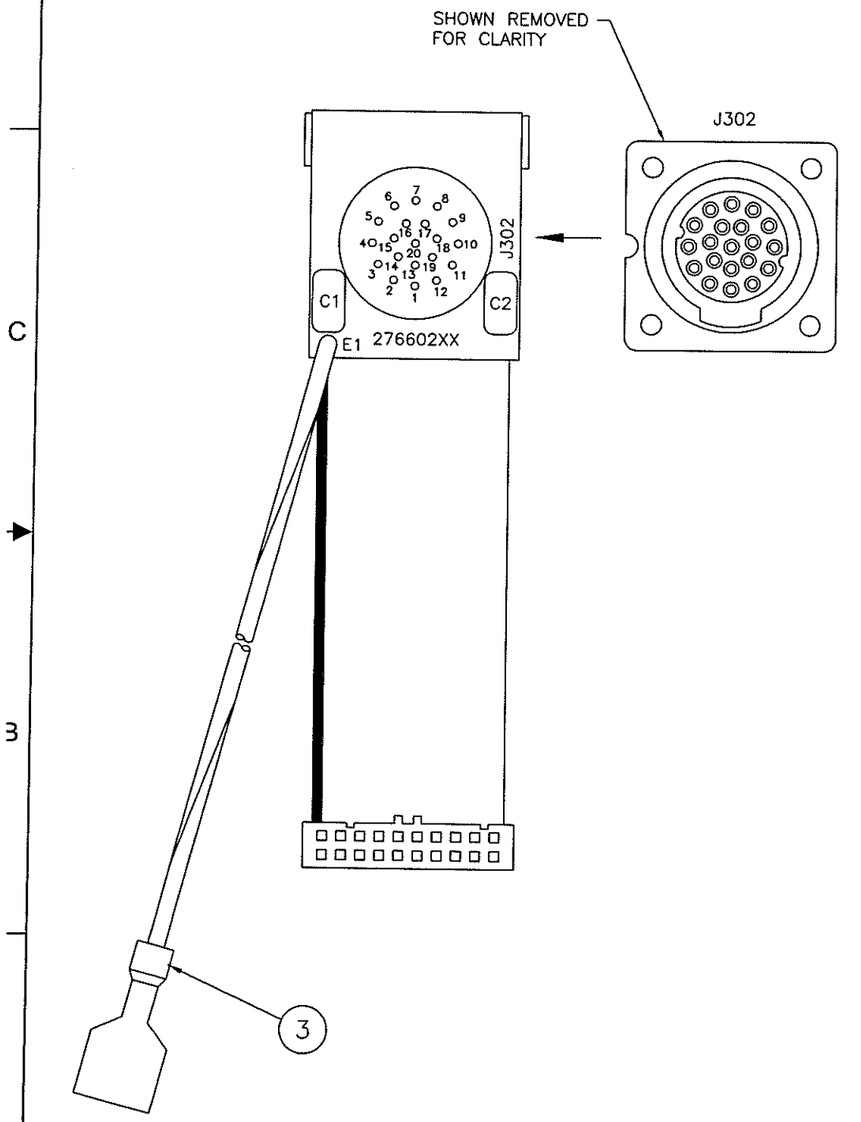
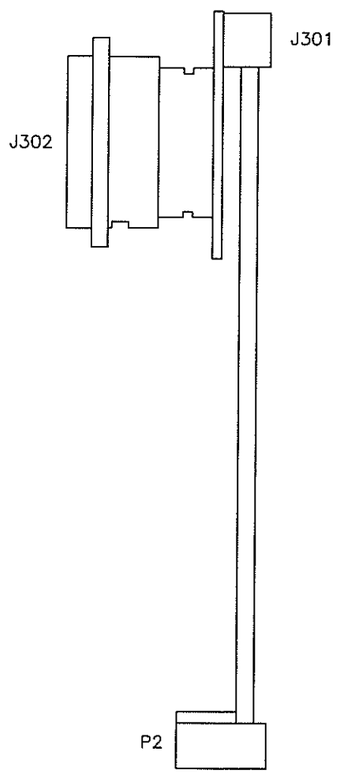
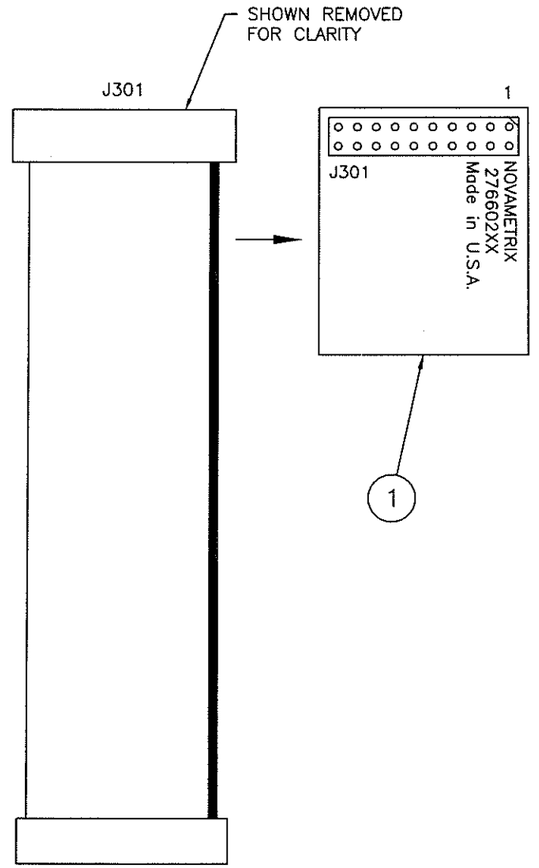
Medical Systems, Inc.
5 Technology Drive
Wallingford, CT USA
06492

Size	Document Number	Code	Rev
B	2765	03	10

Sheet 5 of 5







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01	N766	22Jun00
REV	R NO.	DATE

DO NOT SCALE
UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES (mm)
BREAK ALL SHARP EDGES

.X ±.02 TOLERANCES
.XX ±.01
.XXX ±.005 FRAC ±1/64
.XXXX ±.0025 ANG ±1/4°

MATERIAL ~

FINISH ~

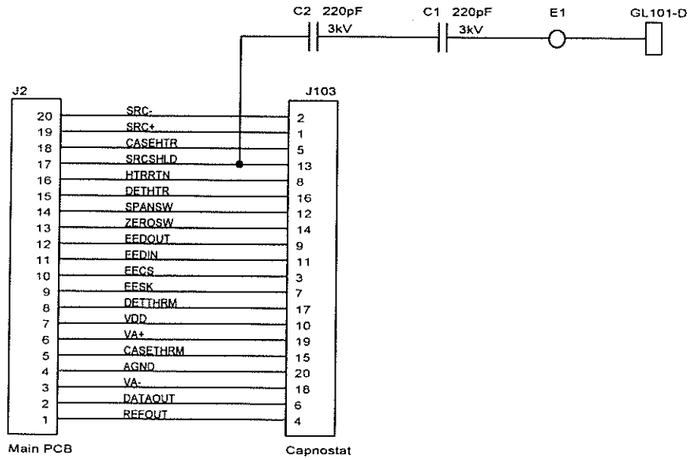
DRAWN	Bob Lancaster	30Nov98
CHECK	MRL	21Dec98
MFG ENGR	T. Carroll	16Dec98
ENGR	RICH DANIELS	18Dec98
PROJ ENGR	DAVE RICH	21Dec98
NEXT ASSY: D9226-01		

NOVAMETRIX MEDICAL SYSTEMS INC.

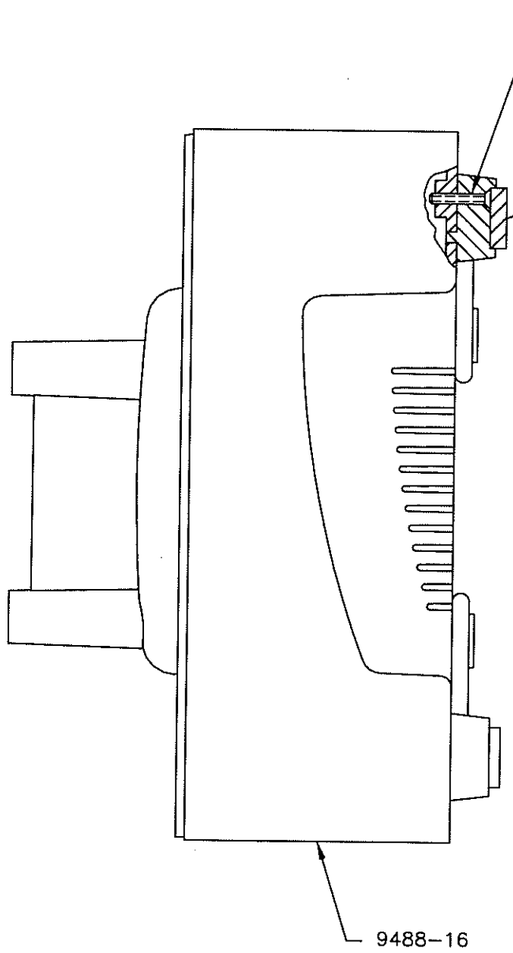
TITLE
CO2 INPUT BOARD ASSY,
MODEL 7300 – NICO

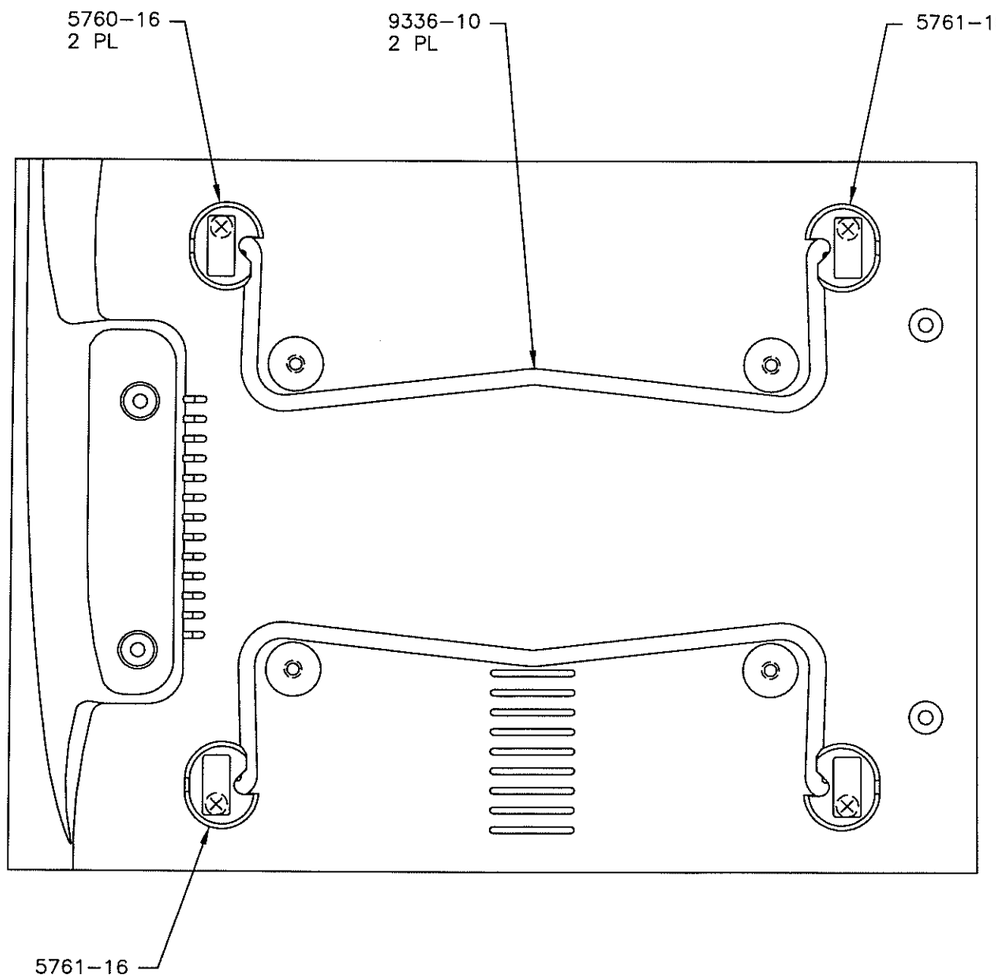
SIZE	DRAWING NO.	CODE	REV
C	2766	01	01

SCALE: 2/1 SHEET 1 OF 1



			SCHEMATIC, CO2 INPUT BOARD		Novametrix Medical Systems, Inc. 5 Technology Drive Wallingford, CT USA 06492		
			Drawn: RHD 15Feb99	Checked: MRL			
			Mfg Eng: MJC 2/23/99	Approved: RHD 2/23/99	Size B	Document Number 2766	Code 03 / Rev 01
01	N766	21Jun00	File: 27660301			Sheet 1 of 1	
Rev.	"R" No.	By Date	Date: Thursday, June 22, 2000				





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REV	R NO.	DATE
00	CO_N0020	26Nov02

DO NOT SCALE
UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES [mm]
TOLERANCES
.XX ±.01 [.254]
.XXX ±.005 [.127]
.XXXX ±.0025 [.064]
FRAC ±1/64
ANG ±1/4°

☐SOLID MODEL ON FILE

DRAWN BL	DATE 110ct01	
CHECK MRL	DATE 20DEC02	
MFG ENGR T.Carroll	DATE 20Dec02	
ENGR DME	DATE 12/20/02	
PROJ ENGR E.P.Wigforss	DATE 12/20/02	
NEXT ASSY: ~		

novametrix™ EVERY BEAT, EVERY BREATH, EVERY LIFE

TITLE
BOTTOM COVER ASSY,
FOR SERVICE, 7300

SIZE	DRAWING NO.	CODE	REV
B	9488	01	00

SCALE: NONE | SHEET 1 OF 1